N THIS ISSUE: The Airplane in Hydro-Electric Development in the West

JOURNAL OF ELECTRICITY

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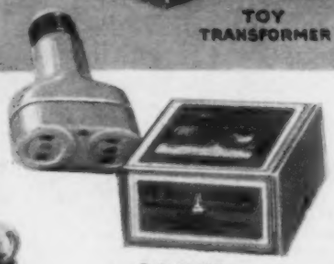

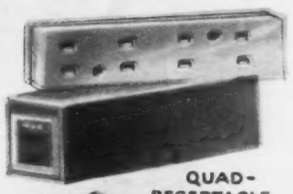

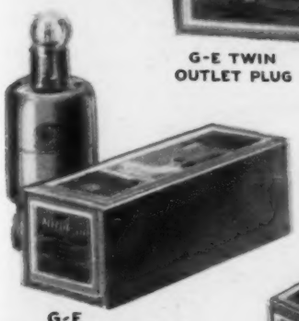

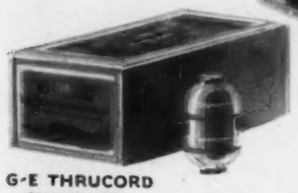

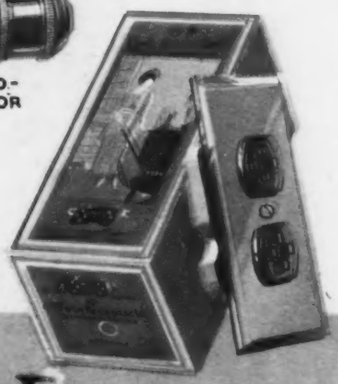

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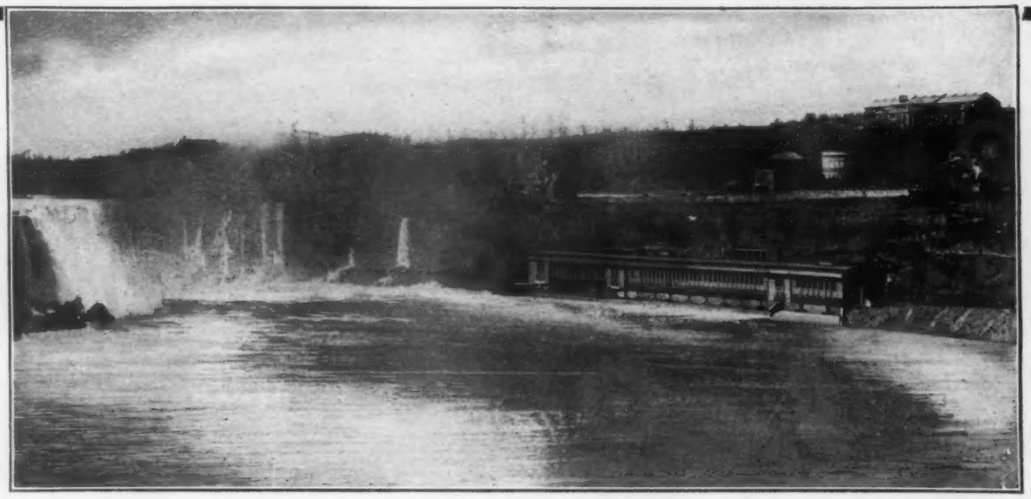

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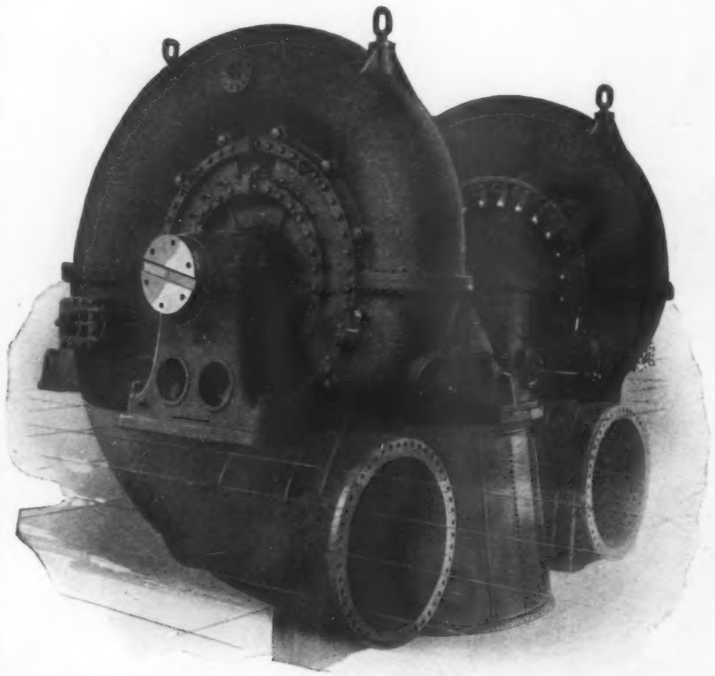

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JOURNAL OF ELECTRICITY

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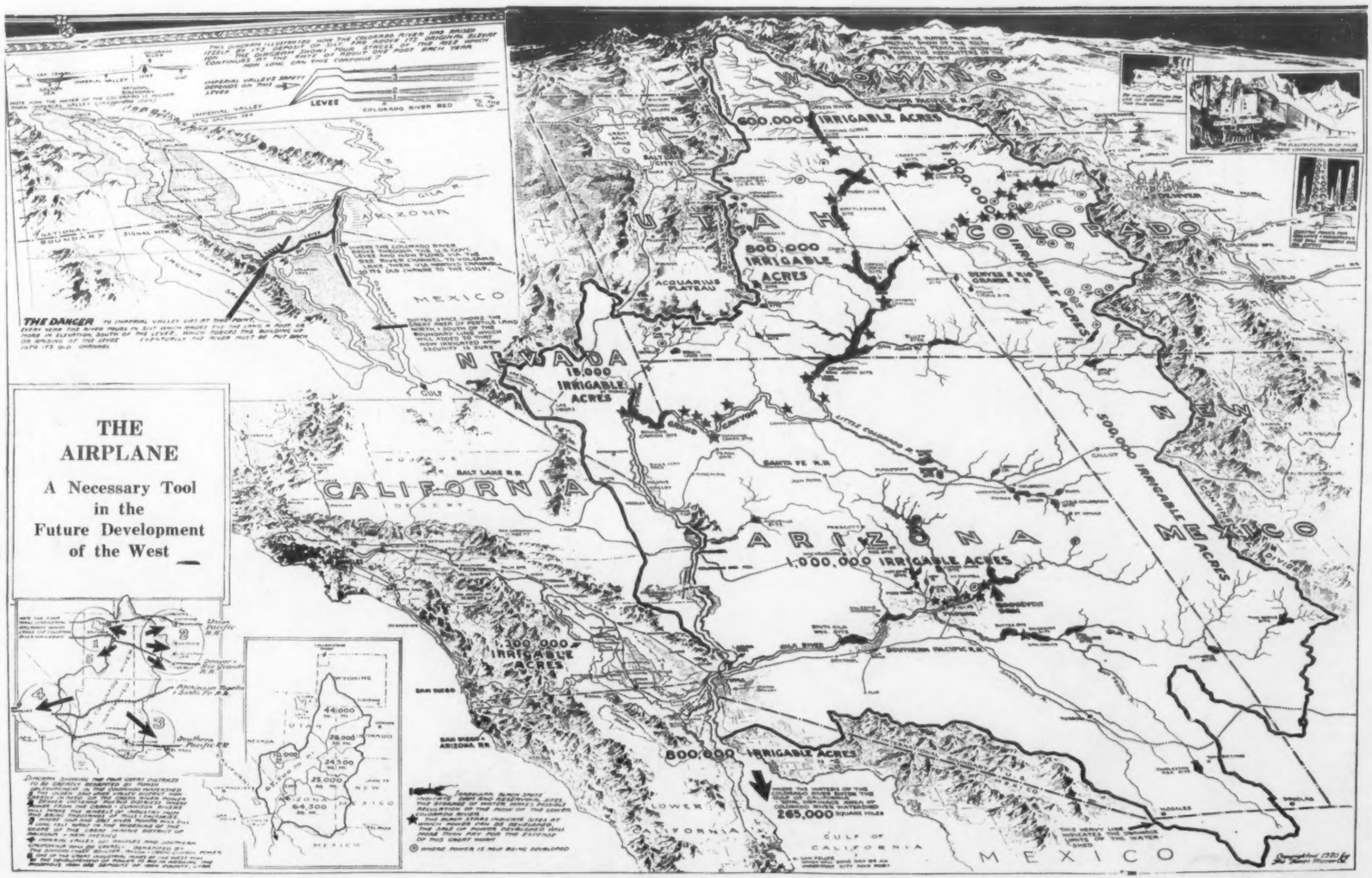

THE GREAT BASIN OF THE COLORADO

The development of this river of the Southwest and of the 265,000 square miles which it drains means more to the West than the construction of the Panama Canal. It means the generation of 2,000,000 horsepower for the supply of four trans-continental railroad lines and the homes and factories of 1,000,000 people, and the irrigation of 1,500,000 arid acres with a productive capacity of $150,000,000 annually. Already enterprising engineers in convention assembled have discussed the possibility of building a six hundred foot dam on the Colorado River at the point where it makes a noticeable turn to the left on the Arizona-Nevada border line, which would bring about the storage of 25,000,000 acre-feet of water in addition to a gigantic power development. The collection of data for this map was very materially assisted by airplane service, and indicates the possibility of the airplane in the future industrial, agricultural and hydroelectric development of the West.

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JOURNAL OF ELECTRICITY

DEVOTED TO THE UPBUILDING OF THE ELECTRICAL INDUSTRY IN THE WEST AND IN THE COUNTRIES BORDERING THE GREAT PACIFIC

Volume 45 SAN FRANCISCO, OCTOBER 15, 1920 Number 8

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Keeping Engineering Leadership in the West

¶ To the skill and daring of its engineers, the West owes much of the record of its achievement along all lines of agricultural, industrial and scientific development. In the close dependence of its future upon the use of its water powers and the electrical service of its industries and farm lands, it is still to the engineer that the West must look for the leadership in its advancement.

¶ The development of engineering schools, therefore, which shall rank second to none and which shall produce men with the training and the vision to carry on the work of harnessing the great natural resources of the West is a primary requisite, if this region is to follow along the lines of great achievement which its pioneers have established.

¶ Unfortunately western universities, and in particular the scientific and engineering schools of these universities, have suffered somewhat from the post war period of high costs, increased enrollment and tremendous industrial development which have called men from the university ranks with offers of salaries commensurate with their technical training. The electrical industry has viewed this gradual weakening with some concern and has been one of the first to criticize in specific instances where it has felt criticism was due.

¶ In all justice to the universities, however, it must be said that their deficiencies have in most instances been due to a lack of funds created by a suddenly doubled enrollment, together with a system of financing which was designed to meet conditions of an earlier period. Such a situation has led the University of California to apply for a new method of financing which shall provide a steady income proportionate to the wealth of the state and therefore roughly proportionate to the demands made upon the University. This measure will appear upon California ballots this fall as amendment 12 and is deserving of thorough support.

¶ The universities should be held strictly accountable for the character of the technical training they are providing—but at the same time it is the reciprocal duty of the electrical industry which is so much concerned in this result to see to it that the universities are properly provided with funds. Amendment 12 in California is one step in this direction and one upon which the electrical industry should vote Yes in the coming election.

The Airplane in Water-Power Development

The forced wartime development of the airplane was so rapid and phenomenal that the world at large has not had time to become accustomed to it as a sane and conservative medium of transportation in everyday life. To the average citizen there is still something desperate and almost melodramatic about aviation, because his mental processes have not had time to dissociate it from the hair-raising adventures of the army and 'stunt fliers.'

The close of the war released large quantities of aviation equipment, and large numbers of trained fliers, and the events of the past two years have paved the way for the peace-time utilization of this material, and for a more normal attitude towards air travel. The forest patrol service, for instance, has done excellent and efficient work during the past season, and in 409,965 miles of flight records only three fatalities, all in one accident. Collected figures go to show that flying, other than stunt flying, has a safety factor which compares favorably with that of any other means of transportation.

The latest and most interesting developments are in connection with hydroelectric construction work, where the airplane bids fair to be of unparalleled service. Articles in another part of this issue point out the various advantages, which include speed of transportation, emergency work, facilities for mapping and inspecting precipitous regions, and distinctly lowered costs in districts which would entail expensive road-building for hauling by motor truck.

The hydroelectric program of the West makes this subject of particular interest in this section of the country, where the mountainous topography and the inaccessibility of some of the great water sources bring out the special advantages of air service.

It is characteristic also that the West should be foremost in the practical application of the airplane in hydroelectric development, several Western

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companies having made considerable use of airplanes in this connection, both for mapping and inspection purposes, and in the rapid transportation of personnel from headquarters to the scene of construction.

It is hoped that the data presented in this issue of the Journal of Electricity will encourage serious consideration of the commercial possibilities of the airplane, and particularly that it will point the way towards an appreciation of its great possibilities in the field of hydroelectric development.

The Increase in Population in the West

The entire interest of the nation is today centered upon the West and the wonderful returns on population statistics that are each day being announced by the Census Bureau at Washington. That California shows a population of 3,426,536, or an increase of 44.1 per cent over the 1910 census, is a statement that has caused all eyes to be focused to the West. It means much for industry, and it means much for new business activities in this section of the nation. When we stop to think that at the present time this one commonwealth of the West is growing at the rate of a million people a decade, and that these people are of a very high order of citizenship with a personal wealth far above the average, it is not difficult to see the effect on industry in general and on the electrical industry in particular that this influx will have as the years continue to roll by. While there have been greater increases in percentages during previous decades in statistical census reports, there never has been on record in the West such a gigantic total in population for a ten-year period as this million increase shows in California for the last decade.

What If Mineral Fuels Gave Out?

If suddenly the supply of all mineral fuel—coal, petroleum and natural gas—should be shut off, is there sufficient potential water-power in the United States to supply the light, heat and power now furnished through the use of these fuels? The answer is, No! The maximum annual production of these mineral fuels in terms of power is approximately 7220×10^9 hp.-hr. This figure is 7,220 billions of horsepower hours, and hereafter in this discussion the unit of billions of horsepower hours will be used, a unit quite familiar since the floating of the Liberty Loans. With no storage, the estimated hydroelectric power available but undeveloped amounts to 50,000,000 hp. or 440 billion hp.-hr. annually; with maximum practical storage, this figure would increase about four times. Consequently, there is just one-sixteenth enough water power undeveloped to take the place of non-reproducing mineral fuels, or, if storage is utilized to the maximum, only one-fourth, when we take into account every possible resource of water-power development in the United States, even though these wonderful resources today are the pride of the nation. Wood as a fuel has not been considered.

Maximum annual production of coal is about 700,000,000 short tons, of petroleum about 400,000,000 barrels, and of natural gas about 700,000,000,000 cu. ft. Taking the conversion factor of coal as 11,000 B.t.u. per pound, as an average, of petroleum as 18,500 B.t.u., with 336 pounds to the barrel, and the heat produced by 7,000 cu. ft. of natural gas as equivalent to that produced by one barrel of petroleum, and one hp.-hr. equivalent to 2,547 B.t.u. per hour, the power developed is easily obtained. For coal it is 6,000 billion hp.-hr., for petroleum 980 billions and for natural gas 240 billions, totaling 7,220 billion hp.-hr. The light, heat and power available from these mineral sources is to the power available from unstored and yet undeveloped water powers as 7,220 is to 440 or as 16 is to 1.

Since there is not enough water by 4 to 1 even under maximum practicable storage, the answer to the problem is the development, as soon as possible, of all the water resources in order to save for the future the stores of non-reproducing mineral fuels, the development of still more efficient methods of getting all the heat out of fuels when fuels must be used, besides the development of some reproducing source of power other than water.

Draft Required in Fuel Oil Practice

In the installation and operation of steam electric standby plants, oil fired, throughout the West, it is customary to overload boilers up to 150%, 200%, and sometimes as high as 300% of their rated capacity. The actual horsepower may therefore be very different from the installed capacity. In designing the chimney it is essential to know what capacity is expected from the boilers, and to be guided accordingly. In recent months, however, such unusual conditions have been thrust upon steam auxiliary power plants, due to the unusual demand for power, that all constants used formerly in the design of chimney characteristics have become greatly unbalanced, and as a consequence the question of actual draft required for fuel oil burning in the steam electric power plant becomes one of prime consideration. On another page of this issue appears an extended account of research on this matter; here is set forth just how the draft may be computed, and, in instances where required, may be increased by artificial means. In fuel oil practice the question of the draft required is greatly simplified by the fact that the air does not have to be drawn in through a thick bed of fuel, and there are no ashes or clinkers to complicate the matter further. The resistance offered to the entrance of air to the burners is caused by the checkerwork furnace floor, and as the openings in the checkerwork can be altered at will, it is evident that the amount of draft required in the furnace depends largely on the arrangement of checkerwork adopted. The only way that the actual draft conditions can be ascertained for best efficiency in any one particular power plant is of course through actual study of operating conditions in that power plant. However, the general laws that are encountered in steam power plant generation, where oil is used as fuel, have been studied out and definite characteristics found to prevail. In these days of unusual power demand, would it not be well for operating engineers and

executive engineers to look more deeply into this subject, and see to it that the best and most economic situation prevails in the power plants under their direction in regard to this important factor of draft?

Why Not More Local Pride?

Franklin T. Griffith, chairman of the water power development committee of the National Electric Light Association, and newly elected president of the Northwest Electric Light and Power Association, presented some able thoughts at the recent convention in Spokane of the Northwest Association. But the one thought above all others that stood out was his statement that people of a community should learn to boast about the solvency of the utility company serving that community with that same pride that they boast about the physical service and record in engineering achievement connected with it. This is a vital thing in community spirit, and its resultant helpfulness to the utilities serving that community is of no small proportion. No greater service can be done by men of our industry than to pass on this ideal of promotional helpfulness through the various clubs, organizations, and associations which exist among men of our industry throughout the West, and through which the public may be reached direct.

Water Power Sites in National Parks

As long as the Federal Water Power Act has been characterized by Emerson Hough in the Saturday Evening Post as "the latest menace to the national parks," it might be well to consider briefly this phase of the matter. Isn't it just possible there is another side to the question than that referred to by the author mentioned above?

The Federal Water Power Act was signed by the President only after Secretary Payne withdrew his objections on the assurance that Senator Jones would introduce into the next Congress an amendment excluding national parks and monuments from the Act. The question now is, might not such an amendment prove detrimental to the best interests of many communities?

If water-power developments are to be excluded from national parks then it seems only just that the boundaries of these parks should be fixed. If, on the other hand, it is permitted to move these boundaries at will, then it does not seem that any hard and fast rule should be applied to water-power sites within these confines.

One case in point illustrates this. If the Sequoia National Park in California is allowed to extend its borders north, as now proposed, and as it now seems Congress at its next session will permit it to do, valuable water-power sites will forever be lost to a community which needs every horsepower available in order to continue its growth. In the Kings River area thereby affected, there is known to be half a million horsepower undeveloped.

In the southern part of California there is now not enough water power available to allow a continued growth of the country unless certain watersheds within national park boundaries can be utilized, and it is believed that the beauty of certain regions could be added to rather than detracted from by such developments.

Western Leadership in Electric Welding

Elsewhere in this issue of the Journal of Electricity there appears an account of the ceremonies which accompanied the starting of an electrically operated gold dredge in the world-famous Comstock district of the state of Nevada. The fact that the entire state showed unusual interest in this forward step in the mining industry made possible through the use of electric power, makes the event significant to the electrical industry; but more than this, the dredge is of significance in that it is the only one in existence which can boast of a deck entirely welded by electricity.

This was done at the advice of George L. Hurst of the Bethlehem Shipbuilding Corporation, Ltd., who designed the dredge and even advocated that the entire structure be electrically welded. Now that the practice has proved highly successful in the case of the Nevada dredge, a large one, soon to be constructed in California, is to be entirely welded by electricity. Mr. Hurst estimates that this will mean a saving in cost and in weight of at least 10 per cent.

The 140 by 61 foot deck of the clam shell dredge now being constructed at Pittsburgh, California, is being electrically welded in much the same way as the Nevada dredge, details of which are given in the article mentioned above.

These concrete examples of the extensive practice of electric welding in Nevada and California go to show that the West is taking the lead in a field which offers unlimited opportunity for the use of electricity in industrial construction.

Hunting Troubles in the Mine

The successful operation of the electric drive equipment in the mine is a subject of great importance throughout the West at the present time, where the economic demand for low cost of production is insistent.

According to B. B. Beckett, who on another page of this issue contributes a very interesting article on "Trouble Shooting in Gold and Silver Mines," it has been found that at Goldfield, Nevada, where about one hundred and ten motors were connected, failures averaged four or five per month in motor drive. Slight investigation has in the past been given to this subject of failures in mine drive, hence these data of Mr. Beckett's wherein various discussions of the effect of vibration, dirt in the oil, water on windings, overload conditions, loss of one

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line connection, and original defects of the motor are discussed, are of great timely importance.

The possibilities of the electric drive in the mine are only at the beginning, and the West with its vast potentialities in mining development presents a promising field for ever increasing uses of electricity in the mines.

Selling the Regulating Commission

Revision of construction rulings is to be expected from time to time and with progress in manufacture and construction methods, it is in some measure justified. The necessity of having these revisions made by a body competent of judging their justice is made apparent, however, by the situation in which the state of Washington now finds itself. The state legislature there some years ago passed an act fixing construction standards for power company property with a retroactive clause making it necessary for the power company to have all its lines and other structures conform with the requirements by 1922. It is obvious that any retroactive clause is pernicious, whatever its time allowance for compliance may be, there being always certain equipment which remains in working condition at the end of the allotted period. In this case it is estimated that from one to two million dollars would be required to conform with the law and a strenuous effort is being made to have it repealed.

That no community is free from the dangers of such an act is shown by the fact that similar legislation based on the Washington example was recently introduced into the Utah legislature and only defeated by prompt action. The utility commission with its organization and opportunity for learning the facts of the situation and of framing a fair-minded judgment is obviously the only body which should be entrusted with such rulings. The public should be made to realize that the power company is not seeking to evade a duty but rather to prevent economic loss which in the end must react upon the consumer himself—another example of the fact that the power company problem is not one between the company and the regulating bodies but rather between the company and the people itself to whom the utility commissions must justify their actions or be superseded. This suggests another phase to the continual educational campaign which is becoming the vital basis of central station prosperity—the selling of the regulatory commission idea as the best safeguard to community and company alike.

A Wireless Record For the West

Another world's record has been added to the annals of Western engineering. With equipment designed and built at the plant of the Federal Telegraph Company at Palo Alto, California, wireless messages are being flashed from the new Lafayette station near Bordeaux, France, and caught with perfect regularity across a distance of over six thousand miles by the California station.

The Lafayette radio station, which is equipped with two 1,000-kw. arc radio transmitters, is the largest radio station in existence, both in power and range of the radio set, and in the number and height of towers. The wave length is 23,000 meters, the longest so far employed. The station was placed in active operation on August 21st last, and, after extensive tests had been conducted by communication with the Palo Alto plant, was turned over to the United States Navy Department about the middle of last month.

For the perfection of this record-breaking equipment, credit is due to Western brains and skill; to such men as Leonard Fuller, recently associated with the Federal Telegraph Company, on whom Stanford University conferred the degree of Ph.D. for his research work in this connection; and to R. R. Beal, chief engineer for the company, who supervised the installation and tests at the Lafayette station.

Few advances in modern science have more significance, or more fascination, than this annihilation of distance by wireless communication, and that the West should be responsible for this latest great achievement is one more testimony to the spirit of enterprise and accomplishment which has always characterized the engineering activity of this section of the country.

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WHERE may the lover of good books find timely assistance for the satisfying of his wants, is a question that has so frequently come to the attention of the editorial offices of the Journal of Electricity that we have decided to institute in San Francisco the most complete service of this nature established anywhere in the West. In the offices of the Journal of Electricity are to be found unusual facilities for those interested to find the latest in books that have been published by the McGraw-Hill Book Company, which comprise over eleven hundred titles of the latest and most authoritative works on engineering subjects. The Journal of Electricity hopes to make this service in the West one of far-reaching helpfulness to men of the industry throughout this district. Make known your wants either in person or by mail, and we shall endeavor in every way possible to render the high type of service for which the Journal of Electricity has always stood. Do not only make use of this service yourself, but pass along to your friends throughout the West the information that here they may find the assistance they desire in the matter of the latest in technical, trade, and engineering books.

The Airplane in Modern Hydro-Electric Practice

BY R. C. STARR

(Exact details regarding the resources and characteristics of a drainage area are of vital importance in determining the economic practicability of certain hydroelectric developments. That the data can be most surely and efficiently collected through aerial surveys is proved by actual experience here described by the construction engineer of the San Joaquin Light & Power Corporation. Copyright pictures reproduced here by permission of U. S. Air Service.—The Editor.)

The useful application of the airplane in modern hydroelectric practice is receiving its first real test in America at the present time in connection with the aerial surveys being made by the writer for the San Joaquin Light & Power Corporation in connection with the Kings River hydroelectric project, consisting of eleven plants with a total capacity of 500,000 hp., for the complete development of which a construction program covering a period of ten years is contemplated.

During the late war the airplane proved its usefulness in many ways. Aerial photographs were taken by the thousands, in some areas each day, and close examination and comparison made it possible to determine the location of troops and new batteries. Since the end of the war the army has employed its aviation forces in augmenting the forestry fire patrols and in making aerial surveys of harbors, fortifications, etc. Some of the maps now completed are so accurately made that the location of gun mounts can be determined within a few feet.

The upper picture shows the crest of Mount Shasta, and the lower the slopes where the water runs from under the perpetual snow fields, a typical source of Western water power. The photographs, taken from an airplane at an elevation of 11,000 ft., show the same snow line from different angles.

Many of the large lumber companies in America have adopted this method of making surveys, especially in Washington, Oregon and Maine, where the ordinary method of surveying and cruising would be extremely expensive, on account of the very dense underbrush in these localities. Data on the density of the timber growth, taken from aerial photographs, is used in the location of saw mills, logging chutes, etc., and enlargements of a part of the photographs enable the lumber man to determine the kind and quality of timber in a certain locality.

As is well known by all engineers, the most important factors in the design of a hydroelectric project are drainage area, precipitation and run-off. These must be accurately determined before the available horsepower and the economic capacity of reservoir, conduit and plant, can be determined. There is access, of course, to all records of stream flow for areas similar to those to be studied, but it remains to obtain the accurate drainage areas and their exposure and character before the records of stream flow and precipitation from other watersheds can be used with any degree of accuracy.

It is a well-known fact that the precipitation on different watersheds of similar character, adjacent to each other, varies to a considerable extent, due to the general direction and velocity of the wind currents, and to other factors such as the average slope of the drainage area, which affects condensation, precipitation and the run-off period. For example, the precipitation on the long flat slope of the Sierra Nevada range east from Sacramento to Lake Tahoe and Truckee increases until an elevation of approximately 6000 ft. is reached; above that there is a decreasing amount of precipitation to the divide. That this condition does not exist, however, on the drainage areas of the San Joaquin River in the San Joaquin Valley is shown by precipitation records at the Kerckhoff plant, Crane Valley and Huntington Lake, on the San Joaquin River; and at Trimmer, Balch Camp and Lake Wishon, on the North Fork of the Kings River.

Other important factors in run-off are the character of timber growth, amount of smaller vegetation and depth of soil obtaining on a drainage area, and the percentage of total area exposed to the sun's rays. The areas above 11,000 ft. on the Sierra Nevada

WIRELESS TELEGRAPHY was invented by Marconi in 1900, but wire is still used for clothes lines. If you have any to sell,

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An airplane picture of Alturas, California. The accurate and detailed view of a wide area obtainable in an air photograph makes the airplane an unequaled medium for collecting topographical data with ease and dispatch.

ranges, not reached by the afternoon sun, always maintain the late summer flow best, and ranges with southern exposures always have early run-offs. A watershed combining these two conditions, as does the Kings River drainage area, provides a long run-off period.

Special Accuracy of Air Survey

To obtain the average per cent of drainage area covered by vegetable growth and timbered area in any other way than by airplane would be very expensive and a mere approximation. A mosaic map made from aerial photographs will show in detail the exact amount of a drainage area covered by timber growth.

In studying large projects, such as the Kings River project of the San Joaquin Light & Power Corporation, the proposed developments of the Southern California Edison Company on the San Joaquin River, and other projects, field surveys must of course first be made to check the government quadrangles as to the accuracy of the elevations in the beds of the streams. It is a well-known fact that while the government quadrangles are a very good guide, elevations, especially in the bottom of streams, are not exact. The United States Geological Survey, in making the quadrangles, obtains accurate elevations at triangulation points, and uses stadia in obtaining stream elevations, etc.

On account of the length of time which would be required to make completely accurate surveys and topographical maps of sections covered by a quadrangle, drainage areas and contours shown are only more or less accurate.

Studying Details of a Drainage Area

The most important part of the drainage area is that near the summit, especially on account of the fact that at this point in the Sierra Nevada range are to be found many small glacial lakes. With especial reference to the North Fork of the Kings River drainage area, where a field reconnaissance has recently been made, there are to be found dozens of such lakes at elevations from 10,000 to 12,000 ft., where very cheap storage reservoirs can be made by driving tunnels or making open cuts through the granite barrier forming the rim of the lakes, and building dams 10 ft. to 20 ft. in height at such points. These reservoirs can be developed for from $10.00 to $25.00 per acre-foot.

The most economical capacity for which these reservoirs should be developed is absolutely dependent upon the drainage area, and the only method by which this drainage area can be accurately and economically surveyed is by the "aerial picture" method, as it would be impractical to attempt a ground survey on account of the enormous expense. The use of the airplane also prevents the possibility of some mountain reservoir sites being overlooked on account of their distance from any trail and the time required to cover the entire drainage area on foot and horseback.

For the foregoing reasons the writer has recently devoted considerable time to the study of methods employed by the War Department in France and in this country in making aerial surveys of fortifications and other government projects.

Aerial Surveys of Kerckhoff and Kings River Projects

As a preliminary test of the methods employed by the government, an aerial survey was made of the Kerckhoff project on September 25. The aerial survey was entirely successful and checked favorably with actual ground surveys, and a similar survey of the entire Kings River projects, including a drainage area of 200 square miles, is being completed at the present time. The base of these surveys is Forkner Field, Fresno. A Varney Lincoln-Standard plane with a 150-hp. Hispano-Suiza motor belonging to the writer is being used. A special aerial camera belonging to the War Department, known as the G. E. M., manufactured by the Eastman Kodak Company, mounted on a special tripod in the cockpit, is being used for the photographs. Lieut. F. T. Honsinger, of the Ninth Corps Area Air Service, is piloting the

plane, and R. L. Bryant, assistant engineer, construction department, San Joaquin Light & Power Corporation, is official photographer. Mr. Bryant had charge of the original field triangulation surveys of this project, reporting to Wm. H. Becker, resident engineer on the Kings River project.

On account of the high elevations from which these photographs are being taken, special high gravity aviation gas is being used.

Major H. H. Arnold, in charge of the Air Service, Ninth Corps Area, with headquarters at San Francisco, also Captain A. D. Smith, Lieut. H. A. Halverson, Lieut. J. R. Morgan, Lieut. Miller and Sgt. Russell, all of the Air Service, have been of great assistance to the writer in connection with the study of this problem and in connection with the aerial surveys which have been made by the San Joaquin Light & Power Corporation.

Methods Employed in Making Air Surveys

Before an air survey of a drainage area is made it is necessary to lay out the aerial work to be done on a map of the area to be surveyed. All flying is done by compass and from certain fixed points, the distances between which are determined by the elevation from which the photographs are to be taken, so that photographs will lap slightly on all sides. A certain amount of field work must first be done in establishing triangulation points, which can be picked up from the air. These serve as a basis for laying out the "mosaic," which is made by piecing together the photographs taken from the air.

It is readily seen that in order to obtain an exact scale map by aerial photography it is necessary to fly different sections at different heights. For this reason, the area to be photographed is divided into sections, and areas from 1,000 to 5,000 ft. in height are flown at a height of 10,000 ft.; sections from 5,000 to 8,000 ft. in height are flown at 13,000 ft.; sections from 8,000 to 10,000 ft. are flown from a height of 15,000 ft., etc.

In taking the photographs the first thing to be established is a base from which to fly a given area. The elevations at which photographs are taken are recorded by altimeters located in the plane. Levels are used on the camera to see that it is taking the photographs in a vertical plane, and a drift set is used to determine the amount of drift, so that the camera can be set at a slight angle with the plane, to allow for the drift of the plane during the flight.

Aerial photography requires the services of two men—pilot and photographer, and it is very essential that communication between the two be possible at all times. This is accomplished by the use of a small tube connecting the two. It is necessary for the pilot to level his plane whenever the camera man is taking a picture.

The work which requires most time is the development, enlarging and fitting together of the various prints, as it is necessary to enlarge some photographs to fit others, so that they may all be made on the same scale. The great value of such a map when completed lies in the accuracy with which all prominent features can be picked out, and the fact that any portion of the map can be enlarged to any scale to obtain detail.

After the map is made, by comparing the same with the quadrangle elevations, contours can be sketched with great accuracy, and the actual lengths of proposed schemes for tunnels, conduits, etc., can be obtained with much greater accuracy than in any other way, without making complete ground surveys. Preliminary studies of possible schemes of development can then be made before complete ground surveys are made from the preliminary layout on paper location.

Aerial Railroad Surveys

The same general scheme can be followed in making a reconnaissance and preliminary paper location for a proposed railroad or highway. Thousands of dollars are spent usually in determining the best and cheapest route, and a locating engineer always feels that perhaps somewhere there is a pass which he knows nothing of, as hours and hours of walking and horseback riding are necessary to reach every possible location. A preliminary reconnaissance by airplane, and later aerial photographs and studies of the government quadrangles where obtainable, make an error of this kind almost impossible, and the writer believes future railroad preliminary surveys will largely be made by airplane.

Airplane view on Fleming Creek, elevation 9,800 ft., showing one of the many mountain lakes in this country and the typical drainage area. Fleming Creek is a tributary of the North Fork of Kings River, and its development forms part of the great 500,000-hp. project of the San Joaquin Light & Power Corporation, in connection with which the airplane has already been used to a considerable extent.

The writer wishes at this time to thank the management of the San Joaquin Light & Power Corporation for their support in undertaking the "aerial" method of mountain surveys, as it always requires courage to be the first to put theory into practice. The results obtained, however, have proven beyond doubt the value of these surveys for preliminary studies of large hydroelectric projects.

TELEPHONES were invented by Bell in 1876. Don't swear when the number you called 'does not answer':

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In the inspection of drainage areas, the investigation of snowfall conditions, the mapping of precipitous regions, and the speedy transportation of men and supplies, the airplane bids fair to become an important factor in hydroelectric development in the West. This view, reproduced by courtesy of the Photographic Section of the U. S. Air Service, shows the upper drainage on the west fork of Kings River.

Airplane Costs in Hydro-Electric Work

BY ERNEST W. DICHMAN

(Economies in hydroelectric construction work will mean much to the West in carrying out its tremendous power program of the next ten years. That the use of airplanes in this work can be not a visionary impossibility, but a practical business venture, in safety, reliability, speed and lowered costs, is brought out in the following article by the chief of Structures and Aerodynamics Branch of the Engineering Division of the U. S. Air Service.—The Editor.)

In 1909 when Orville and Wilbur Wright first made a successful attempt at flight in a heavier than air machine, the airplane was looked upon as an interesting invention and few people beyond the most visionary predicted that it would serve any useful purpose or even be more than a mere curiosity.

Under circumstances such as these it is not surprising that the development of the airplane progressed rather slowly until the beginning of the war in 1914. Not long after the commencement of hostilities the airplane proved its value as an aid to military operations; first for purposes of scouting and artillery observation, later for bombing, and finally in the development of the single-seater fighter as a combatant arm of the service.

The rapid development of the airplane produced a wealth of technical information unparalleled in the history of any science, and it can be said without exaggeration that during the war the science of aeronautics made a stride equivalent to fifty years of peace time development.

Consideration of Commercial Possibilities

The post-war period, while not furnishing so great a stimulus to airplane development as war conditions made possible, permitted the airplane to develop in a firmer and more stable manner. Quite naturally its commercial possibilities were considered, and as a result we have the London-to-Paris aerial transport service, the aerial mail, and a large number of smaller transportation projects. The peace time uses to which airplanes may be put are many and varied, but in any event, whether they be used for transportation of people or materials, for advertising, mapping, photography, forest patrol, or merely for pleasure and sport, the problem in its final analysis is one of costs in proportion to service rendered,—initial cost and costs of operation and maintenance. In order to prove itself a sound investment any plan for the use of airplanes must earn a substantial income or else perform some function more efficiently and economically than existing methods permit.

Adaptability of Airplanes to Mountain Construction Work

A plan for the use of airplanes which should be of particular interest to engineers of the Pacific Coast generally is its employment as a carrier of men and material in connection with construction work in the mountains. This applies equally well to mines, hydroelectric developments, or the construction of water supply systems. Often the construction camp is but a few miles distant from the nearest railroad station, yet because of the character of the terrain the haul is a long and consequently expensive one. The airplane can here be used to transport men and material, often eliminating the necessity for building a road; or used as an adjunct to motor haul, may keep the construction camp supplied during seasons when roads are impassable. The airplane is also exceptionally well adapted to the rapid transport of officials from the main office, or of small but vital pieces of machinery from the factory in cases of emergency to any power house, substation, or construction camp. The distances in such cases often run into hundreds of miles, and the time consumed in transit would be reduced from days to hours.

Factors in the Success of Aerial Transportation

Let us first examine the necessary characteristics for a successful aerial transport system. Listed in order of their importance they are as follows:

I. Safety
II. Reliability
III. Speed
IV. Costs in proportion to service rendered.

I. Safety in Flight —

In time of peace safety in flight is undoubtedly the most important consideration. No one would be justified in taking unwarranted risks with human life to secure greater speed or lower costs of operation. Unfortunately there exists in the mind of the uninitiated a firm impression that flying is a very hazardous occupation and for that reason many people are timid about making a flight. In this connection an article quoted below from the Boston Transcript of December 11, 1919, serves to refute the popular impression on the danger of flying as a commercial proposition.

"British Register 21,000 Aerial Trips in Six Months with Only Two Fatal Accidents. None of 52,000 Passengers Killed.

"London, December 11.—Statistics of the safety of civil aviation are given in a synopsis published by the Air Ministry of progress between May 1 and Oct. 31. The figures (approximate only) are as follows:

Number of flights	21,000
Number of passengers	52,000
Mileage	303,000
Accidents	13
Fatal accidents	2

"Both the fatal accidents happened to pilots. Six pilots and ten passengers were injured, or one passenger injured for every 5,200 carried."

Statistics on file with the Air Service show that less than 5 per cent of all accidents which do occur are due to defects of the airplane structure, and the remaining over 95 per cent of accidents are due to the pilot's carelessness or poor judgment. Safety in flight is really measured by the pilot's ability, and a careless pilot, as a careless chauffeur or locomotive engineer, can endanger the lives of his passengers. It will not be possible to digress in order to explain what constitutes a first-class pilot. Sufficient to state that it requires a long training combined with natural common sense, and a lack of any desire to play the fool. During the war a great number of excellent pilots were produced.

II. Reliability —

Reliability of a service such as proposed would be measured by its ability to run on scheduled time in spite of severe weather or other causes for delay. The most important factors contributing to the reliability of an aerial transport service are the ability of the engineering force properly to maintain the airplanes and engines and keep thm in perfect condition; the kind of weather encountered in the territory to be served, and the ability of the pilot to use his engines as advantageously as possible and not to abuse them.

An indication of the extent to which airplane operation can be relied upon may be obtained from the records of the aerial mail service between New York and Washington for the fiscal year July 1, 1918, to July 1, 1919, given below:

Total number of trips possible	1,435
Total number of trips attempted	1,387
Number of trips defaulted	47
Number of trips in fog	511
Number of trips in clear	918
Total number of miles traveled	160,066
Per cent of performance	93.81%
Number of forced landings due to motor trouble	36
Number of forced landings due to weather	33

A per cent of performance varying from 83% in the winter months to 95% in the spring and 99% in the summer and fall, giving an average of 94% for the year, is a very encouraging figure. Especially so as the climate along the Atlantic coast is very severe with extensive ranges of temperature for summer and winter. With mild winters such as are common in California it is certain that the figure of 80% for the winter months would be considerably bettered.

III. Speed —

Speed of course is the big advantage of aerial transport. In addition to a flying speed of from 100 to 125 miles per hour characteristic of our latest machines, it is possible to steer a direct course for the objective instead of having to take a circuitous route and follow the contour of the terrain as in the case of railway or automobile. This last point is an important one in the consideration of the use of the airplane as an aid to hydro-electric construction. To illustrate let us say, for example, that the camp is twenty miles distant from the nearest railroad by air line and at an increase of elevation of 4,000 feet. Assume the haul by road is forty miles, which being twice the air line distance is a fair estimation. Under circumstances such as these a motor truck would make the round trip in two days, while mules would require at least four days for the round trip. For an airplane with a speed of 90 miles per hour, one hour would be sufficient time for the round trip and include one-half an hour for loading and unloading. On the assumption of an eight-hour day this means that the airplane is sixteen times as fast as motor trucks and thirty-two times as fast as mules.

IV. Costs in Proportion to Service Rendered —

Let us now turn our attention to the important subject of the cost of such a system. Of course, no detailed statement of costs can be made until we know the particular conditions under which such an aerial transport system is to operate. These particular conditions are listed below:

1. The length of the air haul which would be equivalent to the air line distance between the two points.
2. The difference in elevation between the two points.
3. Approximately the total amount of material to be hauled, and the character of this material—namely, bulky or compact.
4. The availability of landing fields at both station and camp, and the character of the intervening country.
5. The weather conditions encountered in the territory to be served.

HYDROPLANES were invented by Curtiss in 1911. If you want to introduce a new line to commuters,

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Upon a study of the above conditions the following points can be tentatively decided:

1. The size and type of airplanes.
2. The number of airplanes.
3. The number of trips per day and the schedules.
4. The load to be carried per trip.

Costs may then be divided into initial cost, maintenance cost, and depreciation.

Initial costs include:

1. Purchase of airplanes.
2. Preparation of landing fields.
3. Erection of hangars and machine shops.

Maintenance costs include:

1. Maintenance of airplanes.
2. Maintenance of landing fields.
3. Maintenance of hangars and machine shops.
4. Salaries of pilots and mechanics.

Depreciation includes:

1. Depreciation of airplanes.
2. Depreciation of hangars and machine shops.

A study of the above costs for any particular set of conditions permits us to predict with considerable accuracy the cost per ton and hence the cost per ton mile of transporting material from railroad to camp.

Referring to our previous example, where a twenty-mile air haul was equivalent to a forty-mile road haul, it was shown that an airplane was sixteen times as fast as a motor truck and thirty-two times as fast as mules. This means that an airplane capable of carrying 3000 pounds load could take the place of five 5-ton trucks or of sixteen 3-ton wagons each drawn by four mules. Allowing one pilot for each airplane each pilot would take the place of five chauffeurs or sixteen teamsters.

The cost of constructing and maintaining a road from station to camp is an exceedingly large item. With aerial transportation in place of this expense there would be the preparation of two landing fields which often would not require a day's work to be suitable for their purpose.

In order that the economies to be effected by employing aerial transport may be definitely brought out, a direct comparison has been made between the costs of hauling by motor in connection with construction work in the mountains and these same costs had aerial transport been employed.

Costs of Motor Transportation

In 1917 the cost of motor hauling on mountain roads ran about 35 cents per ton mile, exclusive of the cost of road construction and maintenance, so that it is safe to assume that present day costs would be approximately 50 cents per ton mile. The cost of mountain road construction is about $15,000 per mile and maintenance $500 per mile per year.

Now let us apply these figures in the case of a construction project in which the following conditions exist:

The air line distance between the nearest railroad and the construction camp is 20 miles.

The construction camp is at an elevation of 4,000 feet above the railroad.

The road connecting railroad and camp is 40 miles.

The project is the construction of a dam, so the material to be transported would be mostly cement.

The total amount of material to be transported is 15,000 tons.

The duration of the job will be approximately two years.

The ground at the reservoir site will have to be cleared anyway, so the expense of a landing field at this end need not be charged to the aerial transport.

The landing field at the station could be prepared for less than $1,000.

The weather in the winter is rainy, rendering the roads impassable for three months.

The cost of hauling by motor would be as follows:

Road construction, 40 miles @ $15,000 per mile	$600,000	
Road maintenance, 2 years, 40 miles @ $500 per mile per year	40,000	
Total cost of road over two years		$640,000
Direct operating costs of hauling 15,000 tons over 40 miles @ 50c. per ton mile		300,000
Total cost of hauling, including cost of road		940,000

NOTE.—The depreciation and repair of trucks, and salaries for chauffeurs and mechanics are all included in the figure of 50c. per ton mile.

The road would of course have no salvage value so that no rebate could be obtained from that source, and therefore the net cost of hauling 15,000 tons of material in two years by motor from the railroad to the construction camp, 20 miles distant by air line and at an increase of elevation of 4,000 feet, entailing a road haul of 40 miles, is $940,000.00, or $1.57 per ton mile.

Let us now investigate the cost of hauling this material by airplane.

Aerial Transport Service Cost Data

For this service we should use two bi-motored airplanes patterned after the bombing airplanes in use during the recent war, but modified by using a high lift rather than high speed wing section, and possibly slightly increasing the area of the wings so that each machine would be capable of carrying 3,000 pounds of useful load.

The power plant of each machine would consist of two Liberty 12 engines each delivering 400 hp. at 1700 r.p.m., but ordinarily operated throttled to 310 hp. and 1600 r.p.m. The average speed under these latter conditions will be 90 miles per hour.

Fuel capacity can be limited to one hour as the round trip can be accomplished in less than half that time. Airplanes will be fueled after each round trip.

Each airplane will make 8 round trips a day. As the air haul is only 20 miles this will allow one ½-hour per trip for loading and unloading.

Each airplane will then be actually in the air less than 4 hours per day so that during one year of 313 days it will have flown 1,252 hours, after which it will be salvaged for 25% of its initial cost. This figure is purposely placed extremely low, as to keep each machine in the air 1,252 hours will require 20% of the original cost expended in replacement parts.

During one year's operation two sets of engines will be used and salvaged. The total running life of each engine will then be 626 hours. The salvage value of each engine will be 50%. During the life of each engine it will be completely overhauled six times and at each overhauling 10% of its original cost will be expended in replacement parts.

A Liberty 12 engine consumes approximately 26 gallons of gasoline per hour when delivering 310 hp. at 1600 r.p.m., so that two bi-motored airplanes actually in the air four hours each day will consume

during a year of 313 days 130,208 gallons of gasoline. Allowing approximately 20,000 gallons per year for taxying, testing spare motors and wastage, the total gasoline consumption will be 150,000 gallons per year.

Oil consumption is less than one gallon per engine per hour, so that the total oil consumption would be 5,000 gallons per year.

A hangar and machine shop for the care of the air planes will be erected at the railroad landing field only. This need be nothing more than a board and batten building where the initial cost is low but the salvage value is only 20% of the original cost.

Three pilots will be sufficient to supply the necessary reserve in case of illness or relief in order to operate 10 or even 12 hours per day in case of emergency.

Total amount of material transported: As each airplane carries a load of 3,000 pounds 8 times daily, the total amount of material hauled would be—

2 airplanes 8 trips each, 3,000 lb. per trip, or 24 tons per day.

Working 313 days per year the yearly haul would be 7,500 tons, and in a two-year period 15,000 tons of material will have been delivered.

CAPITAL INVESTED AND EXPENSES

Property Investment:		
Preparation of landing fields	$ 1,000	
Hangar and repair shop (for two airplanes)	12,000	
Machine tool and hangar equipment	8,000	
Office equipment	500	
Gasoline tank equipment	3,000	
Total property investment	$24,500	
Transportation Equipment Per Year:		
2 airplanes @ $40,000 each	$ 80,000	
8 engines @ $4,000 each	32,000	
Airplane spares, 20% of airplanes	16,000	
Engine spares, 60% of engines	19,200	
Material	10,000	
Total transportation equipment, per year	$157,200	
Over two-year period		$214,400
Direct Operating Costs Per Year:		
Gasoline, 150,000 gals. @ 30c. per gal.	$ 45,000	
Oil, 5,000 gals. @ 75c. per gal.	3,750	
Total annual fuel cost	$ 48,750	
Over two-year period		$ 97,500

ANNUAL SALARIES FOR PERSONNEL

1 Superintendent of transportation	$ 6,000	
3 Pilots at $5,000 each	15,000	
1 Shop foreman	4,000	
2 Rigging mechanics at $2400 each	4,800	
2 Rigger's helpers at $1800 each	3,600	
3 Engine mechanics at $2400 each	7,200	
4 Mechanic's helpers at $1800 each	7,200	
2 Machinists at $2400 each	4,800	
2 Machinist's helpers at $1800 each	3,600	
1 Clerk and stenographer	1,800	
Total annual pay roll	$58,000	
Over two-year period		$116,000

OVERHEAD

Rent and upkeep of landing field	$ 1,200	
Upkeep of buildings	1,800	
Heat, light and power	1,200	
Insurance on buildings and equipment	600	
Office supplies	600	
Total annual overhead	$5,400	
Over two-year period		$10,800

NOTE—Depreciation considered in determining salvage value.

ANNUAL COST OF OPERATION

Transportation equipment	$157,200	
Gas and oil	48,750	
Salaries	58,000	
Overhead	5,400	
Reserve for unforeseen expenses	10,000	
Annual operating expense	$279,350	
Over two-year period		$558,700

INITIAL INVESTMENT REQUIRED

Property investment			$ 24,500
Transportation equipment			157,200
Monthly working capital:	Fuel and oil	(approx.)	4,100
	Salaries	(approx.)	5,000
	Overhead	(approx.)	5,000
Total initial investment			$195,800

SALVAGE VALUES

Hangar and machine shop, 20%	$ 2,400
Machine, tool and hangar equipment, 50%	4,000
Office equipment, 60%	300
4 airplanes, 25%	40,000
16 engines, 50%	32,000
Total salvage value	$78,700

NET COST OF OPERATION OVER TWO YEARS

Property investment	$ 24,500	
Operating expense for two years	558,700	
Total cost of operation for two years	$583,200	
Salvage values of buildings and equipment	78,700	
Net cost of operation for two years		$504,500

It is therefore seen that the cost of transporting 15,000 tons of material by airplane from railroad to construction camp 20 miles distant by air line is approximately $505,000. This represents a saving of $435,000 over the cost of performing the same task by motor truck, or a saving of $29.00 per ton in transporting the material from railroad to construction camp. The comparative figures are tabulated below:

Cost of transporting 15,000 tons of material 40 miles by motor	$940,000.00
Cost of transporting 15,000 tons of material 20 miles by air	505,000.00
Saving due to use of aerial transport	**$435,000.00**
Cost of transporting one ton of material from railroad to camp by motor	$62.70
Cost of transporting one ton of material from railroad to camp by air	33.70
Saving per ton due to use of aerial transport	**$29.00**

In addition to the saving in cost indicated the airplane has the advantage of being able to operate during those seasons when the roads are impassable, keeping the camp supplied with material and allowing the construction to proceed. Of course there are certain limitations to aerial transport, but only a study of the conditions in each particular case can determine whether or not the airplane can advantageously be used. Unfortunately, so much has been written about the airplane in a spectacular vein that this phase of the subject has in the past overshadowed its more useful purposes. However, the time has come for engineers to realize that the safe and sane development of the airplane is due to make it an important economic factor in our daily life, whose points of superiority may be taken advantage of by anyone having the initiative, energy and courage to do so.

FIRE ENGINES were invented by Van der Heide in 1518. If you want one as a tenant for your new garage,

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Commercial Possibilities of Aircraft in the West

BY MAJOR H. H. ARNOLD

(The commercial feasibility of aerial transportation is a logical sequel to the successful use of the airplane in such enterprises as the mail service, the forest patrol, and the mapping of mountainous country by power companies. The author of the following interesting article on the subject is officer in charge of Air Service, Ninth Corps Area, U. S. War Department.—The Editor.)

The considerations which determine the possibilities of utilizing aircraft for commercial purposes are: (1st) The work which can be done by aircraft more efficiently; and (2nd) The availability of suitable airplanes for commercial purposes.

In dealing with the work which ordinarily would be expected to be done by aircraft only so much will

Power sites and drainage areas are usually located in such isolated or inaccessible regions that their mapping or inspection requires large parties and months of work. Two Western power companies are already using airplanes successfully in this work, with great savings in time, labor and expense. The above view was taken from a patrol airplane above the Cascade Mountains in Oregon.

be taken into consideration as has already been attempted in the past by this means of transportation. Such uses of aircraft as exhibition flights and haphazard jitney service for passengers looking for thrills will be omitted as they are probably the best known examples of the inefficient use of aircraft.

Requirements For Landing Fields

Before aircraft of any character can be used efficiently and generally in any locality, landing fields must be provided. These landing fields must be of such a size as to permit the safe landing of all types of aircraft. The size of these fields depends directly upon the speed of the ship which is landing and the elevation of the field above sea-level. At the present time the majority of airplanes utilized have a landing speed of between forty-five and sixty-five miles an hour. This necessitates a field having a perfectly clear run-way in the direction of the prevailing wind of not less than twenty-five hundred fieet. These twenty-five hundred feet should be clear of all obstacles over four or five feet high at both ends for a distance of not less than a quarter of a mile. As the elevation of the field above sea level increases the length of the field increases in direct proportion until at an altitude of about seven thousand feet a runway of at least thirty-five hundred feet is most desirable. The great tendency at this time is toward slower landing speeds for airplanes. With the slower landing speeds will come naturally the possibilities of smaller landing fields. However, this is a subject for the future and not for the present.

Traffic Regulation

In the development of the automobile it soon became apparent to all concerned that in order to safeguard the lives not only of the drivers of the automobiles but also the pedestrians and innocent by-standers along the roads it was necessary to provide laws concerning the use and abuse of automobiles. It is true that local conditions in many cases dictate the laws for certain localities, but there are certain general principles and certain signals which should be applied uniformly to all automobilists in all states.

In the use of aircraft at the present time laws governing the use of airplanes and the qualifications of the pilots are conspicuous by their absence. In a few instances certain cities have taken upon themselves to pass city ordinances, such as City Ordinance No. 620 of the new series of the City of Los Angeles; but this is the exception which proves the rule. It is obvious to everybody who thinks at all on this subject that without laws and regulations governing the use of airplanes in any locality the number of accidents will increase in direct proportion to the number of airplanes in use. It is therefore absolutely essential that with a good landing field which is being used in any locality a set of rules and regulations must be adopted for that landing field.

In order, however, that there should be uniformity in these rules and regulations it is believed to be most desirable that they be based on the general principles adopted by the Inter-allied Aviation Committee which recently met abroad. The principles cover the following subjects:

(1) When and under what conditions trick flying is permitted;
(2) Heights above cities at which flying is permitted in order not to be dangerous to public safety;
(3) Local register and national marks carried by airplanes;
(4) Rules concerning lights on aircraft;
(5) Action of a plane in coming into a strange field before landing in daylight and after dark;
(6) Right-of-way between heavier-than-air and lighter-than-air craft.

Safety Statistics

Commercial aviation at the present time is in its infancy. In England war restrictions on commercial flying were removed on May 1, 1919, and from that date to January 21, 1920, there were 36,000 flights made by civilian aircraft, during which time 66,000 passengers were carried over a total mileage of 619,000 miles. The total casualties during this period were four pilots, one passenger and one innocent by-stander. In the London-Paris passenger service for the year ending August 25, out of 1,635

flights scheduled 1,444 were actually completed. Only six were canceled due to mechanical defects of the airplanes and engines, and out of 1,474 starts made there were only thirty forced landings. This service, according to actual figures, was 94% efficient as far as trips made was concerned. A distance of 323,000 miles was flown by that service during the past year. In the Postoffice Department, Aerial Mail Service, in the United States during the past year 405,000 miles were flown with a total of three deaths.

Successful Commercial Ventures

In Germany a successful commercial line is being operated between Berlin and Frederichshafen. By the use of directional radio it has been possible for this line to operate daily regardless of fog and low clouds which ordinarily are a menace to all aviators.

In the United States little, if anything, has been done toward establishing aerial commercial routes which run with the regularity that is demanded of other forms of transportation. There have been many reasons for this. Among the most important of them are the almost universal feeling that travel by aircraft is not safe and cannot give regular service; the difficulties encountered in aerial transportation in stormy weather; the inadaptability for commercial uses of present type machines which were designed for war purposes, and the great tendency upon the part of most of the pilots now in commercial aviation to capitalize the desire of many people to get thrills. An additional reason is that no firm in the United States up to the present time has put sufficient money into commercial aviation to make it possible to organize a first-class modern, up-to-date commercial transportation company. However, as the horse and wagon gave way to the automobile, so, in time, the automobile will give way to aircraft for certain classes of transportation.

The Forest Patrol

It has been found from actual experience that by means of the airplane a more efficient and complete inspection and observation can be made over large timbered areas than is possible any other way. This is true to such an extent that the aerial forest patrol has come to stay. As an example of what this patrol has done during the past season up to and including September 15, 1920, the following summary of operations is quoted:

Total number of patrols made	1,088
Total number of miles flown	409,965
Total flying time	3,509½ hrs.
Total number fires discovered	1,456

During that time there were only thirty-seven forced landings, and connected with only one forced landing were there any fatalities.

Mapping Isolated Areas

Closely allied with forest patrol is another important use of aircraft — that of making aerial mosaics of isolated areas and areas for which at the present time there are no satisfactory maps available. This use of aircraft is a natural development from the mosaics which were made during the war of areas behind the enemy's lines.

In order to prove the practicability of this method of securing data from sections of the country of which little is known, the Great Western Power Company is at the writing of this article utilizing an airplane to make a map of its dam site, power plant and power line at Almanor Lake, California. In the same way the San Joaquin Light & Power Corporation has purchased an airplane and is making a mosaic map covering the entire Kings River drainage area. This country is so isolated that in order to secure the same amount of information from any other source months of work by several mapping parties would be required. However, by the use of the airplane the entire area can be covered by photographs in about six hours flying time.

The State Forester of Oregon and the United States District Forester of the Sixth District are at this time considering the possibilities of utilizing the airplane to secure accurate maps of the timbered area of the entire state of Oregon. One of the most serious obstacles in fighting fire which is encountered in Oregon at this time is the lack of suitable maps of the timbered area. This hinders action not only by causing fires to be reported in the wrong locality but also by not affording the fire fighting crew sufficient information to go direct to the fire in order to start operations.

The Field For Aerial Transportation

When it is universally known that commercial airplanes leave Portland, Oregon, at six o'clock every morning and land in San Francisco at noon of the same day, and that this service is run regardless of fogs in the Willamette Valley in the north and San Francisco Bay in the south, there will be no lack of business for the commercial firms which have an aerial line between those two points. In the same way when the power and light companies and private timber owners, railroad lines and construction engineers know that airplanes are available with camera attachments which make it possible for them to secure within a few hours information concerning isolated sections of the country, which by present methods would require the services of several surveying parties for two or three months, there will be ample business for such commercial aviation companies as are doing this class of work.

The airplanes and accessories are available at this time. There are plenty of pilots who are only too willing to engage in this class of work, but the confidence of the public in the ability of the airplane successfully to accomplish its missions, and the lack of public knowledge as to the possibilities of the airplane, are the principal drawbacks which have to be eliminated before commercial aviation can be made an unqualified success.

PIANOS were invented by Schroeter in 1717. You can compete with your neighbor's daughter with an electric piano.

THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

Airplanes and Forest Fires

BY PAUL G. REDINGTON

(As a demonstration of the practical civil value of the airplane, the effective work of the Airplane Forest Patrol of the past year is of the greatest interest to industries which are seriously considering the question of business air service. The following article on the subject is by the District Forester of the California District.—The Editor.)

The airplane proved its worth not only in detection but in quick transportation of trained men to the scene of action.

THE success of forestry in the Western United States hinges largely upon the protection of the timber resources from fire. The National Forests in California alone have over one thousand fires per year during the months of July, August and September. The essence of effective fire protection is prompt detection and quickness of dispatch and attack in suppression. The present lookout system, developed during the past twelve years within the National Forests, suffices to cope with the situation under normal conditions. The airplane does not in any sense supplant this principal method of detection, but merely supplements and augments its operation.

Limitations of Lookout Stations

The primary lookouts, located as they are on commanding eminences within the forest areas, have a general view of their field for twenty-four hours of the day. They have, however, inherent difficulties to meet, such as the topographic nature of the area, permitting only a limited direct visibility; and secondly, temporary adverse atmospheric conditions, which sometimes preclude the possibility of any detection. Under such conditions it is that the airplane can serve its function as a valuable supplemental agency.

The usual primary lookout, serving an area of 200,000 acres, may have a direct view of only a small portion of this total, in which he can detect a fire from its very inception. He may be able to detect, on other portions of the area, fires when they have reached a moderate size of one to five acres. There are, however, still other portions, particularly in the deep canyons, from which smoke can only be seen when it comes from a fire having reached a point of extreme potential danger.

Special Advantages of Airplanes

The airplane flying at an average altitude of 10 to 11 thousand feet through the California forests has before it like an open book, canyon and hillside, dense timber and open meadow. No matter how small the fire, a keen observer can note its full character without difficulty. This year a few fires were reported by the airplane which proved to be nothing but extra large camp fires. It was essential to train the observers to recognize the character of the smoke of a small uncontrolled fire.

It frequently happens that a haze covers portions of the National Forests during certain hours of the day when lookouts at the elevations can give no effective detection. The airplane observer, on the other hand, flying at higher altitudes can see through the moderate haze with sufficient accuracy to serve the purposes of quick detection. This is due entirely to the difference of the angles of incidence of the sunlight from the point of view of the airplane observer and the lookout. The same holds true for certain conditions produced by the smoke mantle from a large fire.

In these ways the airplane serves as a supplemental detection agency, where primary lookouts are unable to function fully. It must be pointed out, however, that during the pre-fire season when only a limited number of lookouts have been placed the suppression agencies largely depend upon the airplane for detection.

The success of the forest air patrol has paved the way for the development of civil aviation. In the above map are shown the California forests and the air patrol routes with the main bases and sub-bases. The forest patrol flew 409,965 miles this season and discovered 1,456 fires.

As pointed out, stationary lookouts give twenty-four hours' service. At best airplanes serve for a short specific period during the course of their flight. It is for this reason that with the high hazards existing in California, dependence on airplanes for detection, merely based on two daily trips over any given point, would not meet the needs.

Reconnoitering by Airplane

The airplane this year had ample opportunity to demonstrate its use in connection with definite mis-

sions in fire detection and fire suppression. After a severe lightning storm which covered parts of Northern California, special trips were made over the lightning zones. Lightning fires have proved a source of

The preservation of the great timber tracts of the West is greatly facilitated by the airplane patrols, not only on account of the speed with which fires can be reported but also on account of the more accurate mapping of timbered areas which is made possible. The view above shows a fire in Nez Perce Forest, Idaho, photographed from the patrolling airplane.

great trouble. A tree having been struck may smoulder for a good many days before a definite column of smoke of sufficient size to be picked up by our lookouts will be emitted. The airplane has readily detected such fires.

The chief special use of the airplane this year was made in connection with some large fires burning in the northern part of California.

The Mill Creek fire in the Lassen National Forest was located in an extremely inaccessible territory and covered a very rugged, broken country, which made it almost impossible for the Ranger in charge to keep in touch with all sides of the fire. It would have been out of the question for him to have covered the perimeter of the fire in less than a three days' hard journey. A radio station was set up at the main fire camp and an airplane reconnoitered the entire fire-line twice daily and kept the ranger fully informed by radio of the situation. The patrol work of the airplane after the fire was under control saved a good many hundred dollars daily in the wages of fire-fighters as patrolmen, for whom supervision would have been difficult at best. The airplane was used extensively in transporting fire-crew leaders from various forests to points of dire need, saving days of otherwise lost travel time.

Transportation of Trained Forces

The Lassen National Forest had 32 lightning fires start in one ranger district within a two-day period, which taxed the capacity of the regular force. Large crews of fire-fighters were on hand but there was a decided lack in trained forest officers to handle the crews. Immediate action was required. Fortunately, the Stanislaus National Forest was then enjoying a period of quiet, when the "S O S" was received from the Lassen; a plane was dispatched to the Stanislaus and brought back two forest officers who reached one of the large fires that same night. This saved three or four valuable days. Two days later a break occurred on the Stanislaus, and it called for the return of its men. Again the plane was put into action and the men were back on their forests the same night.

This feature is exceedingly important, making it possible to mobilize and transport our trained forces all over the state. This mobility of trained men was almost entirely lacking heretofore.

Detection Work

In detection the airplane has proved its place. With good trained observers a large percentage of fires can be located within a quarter of a mile. An observer flying over the Shasta National Forest radiographs to the Forest Supervisor, "A small fire, just started in heavy timber, burning slowly, wind N.W." When the plane lands at the base the observer calls up the Forest Supervisor to confirm the message. The local Forest Officer questions whether this is a forest fire, as he had been notified by a cowman that he would burn a carcass in that general vicinity the same day. The observer is firm in his statement. When the Ranger reaches the place, true enough, a small timber fire is slowly eating its way northwesterly up a gentle mountain slope.

Reliability of the Service

By use of radio immediate communication is available to the suppression forces. For the special jobs enumerated no other medium can take its place both as to accuracy and dispatch. Taken in conjunction with the training of an adequate army air personnel, airplane air patrol has a very definite, distinct and valuable use. Twenty millions of acres of National Forest land are viewed practically every day by the observers, besides an enormous area outside, along the patrol routes. Brush and grass fires outside the forests were reported to the state forest authorities, and in this connection the writer desires to record the appreciation of the Forest Service of the splendid spirit of cooperation which was at all times evident with the Air Service, the Signal Service, the State Forester and many public bodies who through direct appropriation of money made possible the preparation of adequate landing fields and the construction thereon of improvements for the housing of the men.

For the number of hours flown—better than 3,000—and for the mileage, which ran up into the hundreds of thousands, the number of casualties was remarkably low. Three men were killed, all through the crash of one plane soon after it had left the landing field at Alturas. But by and large, the air patrol is a safe undertaking, and given good care the great ships are steady, fast and reliable. It is to be very greatly hoped that we shall have a continuation of the Aeroplane Forest Patrol next year and the larger use of wireless telegraphy and telephony.

SUN DIALS were invented in 558 B. C., but if you are going to London, exchange yours for a radium watch:

THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

Cost of Operation for Airplane Service

BY LOUIS H. MUELLER

(The dollars-and-cents practicability of the airplane in commercial life is, next to the safety factor, perhaps the most important aspect for the power man or the business man who is investigating its possibilities. A thorough cost analysis is given below by the sales manager for Walter T. Varney.—The Editor.)

The difficulties of preparing an article on the costs of operating an airplane lies chiefly in the fact that one cannot to any extent rely upon experience as a basis, but must venture predictions on the few facts available. The cost of operating the army planes or war time training planes could not, by any means, serve as a basis for civilian flying, inasmuch as the nature of the flying would be so different; and similarly, the published costs of operation of the aerial mail would hardly serve as an index for the operating costs of the average private owner of an airplane for the same reason. I have divided the costs under the following headings:

1. Fuel and Oil
2. Pilots and Mechanics
3. Depreciation and Renewals
4. Insurance and Minor Breakages
5. Hangar and Field

It will also be difficult to arrive at a final estimate of costs for this particular reason, that the bases of costs in the average in the above mentioned elements differ, one depending on time alone and the other upon the actual amount of flying of the airplane. For instance, the costs under insurance, pilots and mechanics, and hangar and field, depend on time alone. The fuel and oil, and depreciation costs are chiefly dependent upon the amount of flying done.

Since the amount of flying done per unit of time will vary widely with different uses and under different owners, the approximation which will have to be made in order to arrive at a final result per mile, or per minute or per hour, will be an arbitrary figure, and an allowance will necessarily have to be made in each particular case.

Cost Items in a Specific Case

Another difficulty which arises is the fact that there will necessarily be a different operative cost according to the kind of airplane used. Therefore, in order to make this analysis as practical as possible, I shall take for this particular instance the kind of airplane that Mr. Rex Starr, the well known engineer, proposes to use in his surveying trips. This is a medium priced airplane, and one which has been used a great deal in commercial flying. It is known as the Varney Lincoln–Standard, carrying two passengers besides the pilot, and sells at a price of $6,000.00.

1. Fuel and Oil —

The Lincoln-Standard is equipped with a 150-hp. motor. This is a medium powered motor and therefore will serve as a good illustration. It will normally use ten gallons of fuel per hour of flight, and from two to three quarts of oil. Therefore, the approximate fuel cost per hour of flight would be $3.00.

2. Pilot and Mechanic —

The ordinary salary for a good pilot is about $300 per month. For the man who only owns one airplane, the pilot should be picked from among those who have some knowledge of mechanics and therefore would be able to make all minor adjustments upon the plane and the motor. For this reason it will not be necessary to maintain a special mechanic inasmuch as it would be much more economical for the owner in case of serious repairs, or motor overhauling, either to bring in an extra mechanic or to take his airplane to a nearby airdrome where service could be rendered; such service as is being maintained by the Walter T. Varney organization. This would be the most practical way to handle the situation for the ordinary owner.

3. Depreciation and Renewals —

This element of cost is the hardest to estimate in view of the fact that the conditions of commercial aviation are such that, as far as my experience goes, there has been no case of an airplane actually wearing out; and I know that in war time training many a plane was flown for two or three years with very heavy duty. A very conservative estimate of the life of the plane and the motor could be stated as 1,200 hours of flight or operation, this to take place within three years' time, inasmuch as there may be a wearing out of elements due to actual standing around. An airplane is more or less different from an automobile in that it can almost be rebuilt with repairs, so that at the end of perhaps three years there may not be any of the original material present in the plane, but it will still be spoken of as the original plane.

With the above information, which necessarily will vary with individual cases and perhaps not be anywhere near the final figure which will be determined in experimenting, a $6,000 plane, such as the Lincoln-Standard, could be charged off at the rate of $5.00 per hour.

Under this element of cost will also have to be placed such items as motor overhauling, re-covering of wings, etc. From our experience we find that motors in our particular instances will run from 75 to 100 hours before they require a top overhauling, that is, grinding of valves, etc., and from two to three hundred hours before the motors must be generally taken down and overhauled and perhaps one or two new bearings, wrist pins, etc., inserted. Then the motor ought to be good again for from 150 to 200 hours before a repetition of this performance. I have no means of knowing how long this could go on before there would be a rebuilt motor on the original foundation.

The cost of the top overhauling of the motor should not be over $50, and of the general overhaul-

ing not more than $300. An expenditure of $150 over 300 hours ought to keep the plane itself in fairly good shape. I believe that for $2.00 per hour, this element of motor overhauling and plane upkeep could be attended to.

4. Insurance and Minor Breakages —

The insurance rate at this time on commercial aviation is extremely high. We have been obliged to pay a rate of 14% of the amount of the insurance for six months, to cover against losses through fire and through collision with the earth and otherwise. With our Lincoln-Standard plane insured for, say, $5,000, this would mean about $700. Taking into account other insurance—for instance, compensation insurance on the pilot and liability insurance, both of which together would amount to about $600 a year—we would place an approximation of $165 per month on insurance cost; under the collision insurance clause certain small breakages are exempt in the insurance policies. Therefore we might put a total cost for insurance and minor breakages of an approximate figure of $200 per month.

5. Hangar and Field —

The cost of storing a plane on a flying field which is to be used will depend entirely upon the conditions, since the average man who will own a plane will have perhaps a ranch or an estate of his own with open spaces. To some the cost of fields will amount to almost nothing; while to others it will come fairly high. A very good hangar could be built for $1,000. A tent hangar can be purchased for $300. Inasmuch as this element of cost is not an average cost, it will not be considered in the final result. Hangar space is often sold at very good airdromes for from $25 to $50 per month.

Summary of Costs

In combining the above costs to a unit, as before stated, it is necessary to make an estimate of the use of a plane for a given length of time. I would estimate that an average private owner would perhaps not use his plane more than 50 or so hours per month. This of course will make the rate per unit of time higher than if the plane were used more, say 100 hours per month. Fifty hours per month would only represent two hours of flying for twenty-five days in the month, or five hours of flying for ten days. Ordinarily, a man would not want to fly more than five hours in one day. From four to five hours a day was the regular daily work of an army instructor for six days a week.

The time costs would amount to $500 per month, which is made up of the $300 for the pilot and $200 for insurance. The costs depending upon operation could be totaled up to amount to $10.00 per hour of flight, made up of $3.00 for fuel and oil, $2.00 for motor overhaul and plane repair, and $5.00 for depreciation.

The problem of coordination of these two different types of cost as stated before becomes difficult, and depends entirely upon the use to which the plane is put. Under our assumption of fifty hours of flight per month, we would have the time costs amounting to $10.00 per hour; therefore, adding all the costs together we would have a figure of $20.00 per hour of flight on that basis, or in other words, 33 1/3 cents per minute.

When estimating that a Lincoln-Standard at normal cruising speed makes 75 miles per hour, we would have a cost of approximately 26 cents per mile.

In order to give an idea of the effect of the small usage of the particular plane we took for example, assuming that the plane was used 100 hours per month, which is perfectly reasonable and possible, we would have the time costs reduced to $5.00 per hour and therefore the total cost of operation amounting to $15.00 per hour instead of $20.00. This then, would give an operating cost of 25 cents per minute, or with the same assumption of 75 miles per hour a cost of 20 cents per mile.

These figures would compare very favorably with the operation and depreciation costs of a motor car of the same price as the above mentioned airplane.

In generalizing from the example mentioned above, it may be said that most likely a faster machine would require a higher cost per mile in view of its increased efficiency, in the same way that the higher powered automobiles give a higher operating cost.

It will be well to remember that in practically every element entered above, rather high estimates are made. There may be some objections on the part of men experienced in aviation to some of these costs, but most likely in one category the result would be a higher figure while in other categories very likely they would be lower. I believe that in the average the estimates are high.

It will be well to remember, also, that this cost of 20 to 25 cents per mile of flight includes all costs on the plane except that of hangar and field.

BUSINESS LIBRARY SERIES

On account of the large amount of special material contributed to this issue, the second article of the series on "Pamphlets and Clippings in the Business Library," by Miss Virginia Fairfax, has been held over. The series will be resumed in the November first issue.

BAROMETERS were invented in 1626. If you are well equipped for a rainy day you usually get fair weather:

THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

The Rise of Civil Aviation

BY LIEUT. H. A. HALVERSON

(The application of wartime aviation equipment to commercial uses, the reorganization of aeronautic bodies, the extension of facilities, the adjustment of regulations—all these activities are significant of the advent of the airplane as a factor in the business world. A member of the U. S. Army air service here gives an inclusive review of what is being done along these lines all over the world.—The Editor.)

The conclusion of the war not only removed certain restrictions on civil aviation but released extensive equipment and organization for possible commercial use. The resultant facilities are leading to marked activity all over the world.

Economic Hindrances in Central Europe

In Austria much thought is being given to air transport. An Aviation Department has been constituted under the State Secretary of Transport, and provisional regulations for air navigation were issued by a decree of December 10, 1919. But so long as the economic situation remains as unfavorable as it is at present, it is unlikely that civil aviation will develop as rapidly as in other countries. One of the main difficulties is the shortage of petrol. The Luftfahrewesen Gesellschaft (known as "Lufag") has bought up the whole stock of service aircraft. They are being resold under the control of the Disposal Board, 60% of the excess over valuation price realized being credited to the state.

A Department for the administration of civil aviation has been formed in Hungary, the Minister of Commerce employing demobilized officers to assist in this work. This Department is drafting regulations governing the navigation of the air. It is reported that an aerial transport company, known as the "Ungarische Aero-Verkehrs Aktiengesellschaft," has been formed with a capital of 50,000,000 kr. for the purpose of establishing aircraft services. As in the case of Austria, the present industrial and economic state of the country is unfavorable to the development of civil aviation.

Germany's Ministry of Air and Transport

In Germany the organization of civil aviation has been steadily progressing during the last six months, but actual flying has been partially suspended owing to the shortage of petrol and the disturbed condition of the country. Germany now possesses a Ministry of Air and Transport. The Department for Air supervises general questions concerning air traffic, air regulations, aerodromes, aerial photography, the distribution of material, the classification and testing of types, inventions, meteorology and intelligence, wireless telegraphy, and the control of organizations.

The German Government has also established a strict control over the movements of all aircraft. At the beginning and end of each flight proof has to be given of the purpose of the journey. The pilot is obliged to hold a pilot's certificate issued by the State Air Department and, except in the case of flights carried out by air transport companies, a permit issued by the police authorities for each flight. Air transport companies, it is understood, are allowed to issue permits for flights under an arrangement with the State Air Department, to which they are responsible. All luggage carried by aircraft is subject to special inspection.

A number of new transport companies have been formed, and at present there are 25 such companies in existence. Germany has not yet produced a commercial airplane suitable for civil aviation, but many German engineers are working to discover a satisfactory type.

The Government Department For Air and Power Transport (Reichsamt fur Luft und Kraftfahrwesen) has in the supplement to the Home Allowance of the State Transport Ministry for the year 1919 allotted the sum of 500,000 marks as a subsidy for German aviation enterprise. The granting of the subsidy is conditional on the maintenance of air communication and of an air post. In the Home Office grant for 1920, 12,000,000 marks are to be devoted to the same purpose.

The Deutsche Luftreederei has just published a balance sheet for the period February 20, 1919-February 20, 1920. During the year over 3,000 passengers have been carried, and 100,000 kilograms of parcels of goods; 84 machines were used (71 postal airplanes and 13 freighters), which flew 650,000 kilometres.

A Banker's Syndicate in Belgium

A Department of Aviation, autonomous but temporarily attached to the Ministry of War, has been created in Belgium. It is divided into four sections responsible for: (1) the organization of air lines; (2) the exploitation of air lines; (3) general judicial and diverse questions; (4) aeronautical research work.

Navigation Regulations, based upon the International Air Convention, were published on November 27, 1919. Air Attaches have been appointed to London and Paris.

At the present time civil aviation is carried on almost entirely by, or in collaboration with, the National Syndicate for the Study of Aerial Transport which has been formed, mainly by a combination of important Belgian bankers. The Syndicate has prepared a scheme for the provision of facilities on aerial routes for companies with which it has entered into agreement, is arranging to place its organization at the service of the owners of civil aircraft at appropriate charges, and has under consideration the operation of mail and passenger services. During the month of February the receipts from passenger pleasure flying amounted to 34,000 francs, the total expenditure being approximately 20,000 francs. The government has placed 2,000,000 francs at the disposal of the syndicate for the purpose of inaugurating an experimental service of hydro-airplanes and

hydro-glisseurs in the Belgian Congo, a fact which lends weight to a report that it is prepared to grant subsidies for the encouragement of transport companies.

Scandinavia Discusses an Air Code

In Denmark, Norway, Sweden and Finland, further conferences have been held between representatives of the Scandinavian States and Finland with the object of examining the terms of the International Air Convention, and discussing the most suitable form of air legislation.

The first official conference was held in June, 1919, when an air code for these States was discussed. Since that date the conference has assembled at Stockholm in November, 1919, and at Copenhagen in January, 1920. The recommendations with regard to adherence to the International Air Convention rules reached at the last of these conferences are now under consideration by the governments of the respective countries.

Denmark and Norway have appointed commissions under the ministers of Public Work and War, respectively, for the study of air transport and kindred subjects. In Sweden, legislation on civil aviation is effected through the Ministry of the Interior.

An air transport insurance pool representing a combine of some 80 Danish, Norwegian, Swedish, and Finnish insurance companies has been formed. Under its auspices the registration and classification of aircraft and pilots has commenced throughout the Scandinavian states.

Swedish and Finnish companies recently combined to inaugurate a service between Stockholm and Helsingfors, which it is hoped will commence in May or June next. An air ship service between Germany and Sweden has been proposed, and a site for an airship station selected near Stockholm. In Norway an official air Traffic Commission has various schemes for air postal services from Christiania to Copenhagen, and the Norske Luftfartrederi, a private company, has prepared plans for opening a number of routes, including that between Bergen and Stavanger.

Governmental Activity in France

The transference by the decree of January 30, 1920, of the "Organe de Co-ordination General de l'Aeronautique" and the departments dependent upon it from the Ministry of War to the Ministry of Public Works and the appointment of an Under Secretary of State for Air mark a fresh step toward the establishment of French aviation on an independent basis. The Under Secretary of State is now responsible for the Air Navigation, Technical, Aircraft Production, and Meteorological Departments. and has created an Advisory Committee for Aeronautics to study problems connected with aviation. A technical Consultative Committee has also been appointed to the Aeronautical Technical Department.

The French have promoted their interests abroad by increasing their representatives and by establishing a number of missions in foreign countries. In addition to an Air Attache at London, Assistant Military Attaches, with the special duty of studying aviation, have been appointed to Washington, Stockholm, Brussels, Rome and Amsterdam. Official aviation missions have been sent to Argentina, Brazil, Japan, Peru, Poland, Finland, Serbia, Czecho-Slovakia and Turkey.

Consequent upon a reduction in the total French Air Estimate for the current year, there has been a re-grouping of the sums to be expended on civil aviation, with the result that while the subsidies to be given to air transport companies will be augmented, large economies will be effected in the purchase of service aerodromes and hangars. In conformity with the above policy, a new scheme of subsidies has been drawn up, based upon the value of the machine and engine and the number of hours flown. Other salient points are: a bonus to the crew, a premium on useful load and speed, and the additional grant of 25% for machines of military value. In addition to the government subsidy, companies conducting an air mail service receive from the Postal Administration 8 francs for the first 100 grammes, and 1.60 francs for every additional 20 grammes of letters or parcels.

The State has acquired five aerodromes and 24 landing grounds for the use of civil aircraft, and these are placed under the Service de la Navigation Aerienne, which has issued provisional regulations regarding their use. Three aerodromes and six landing grounds have been opened and the remainder are being equipped. Le Bourget and St. Inglevert have been approved as customs aerodromes, and aerial lighthouses have been erected at St. Inglevert and Lille. In addition 13 military aerodromes may be used by civil aircraft belonging to the nations which have signed the Air Convention.

Since September, 1919, an aerial service between Toulouse and Rabat has been operated by the Compagnie de Navigation Aerienne which has obtained a concession from the Spanish Government. The route passes over Spain with stops at Barcelona, Alicante and Malaga. Flights are made twice weekly in each direction. Mails and passengers are conveyed between France and Morocco and by a special arrangement Spanish mails are carried between the intermediate stopping places. The concession granted to the French company is provisional and does not exclude or limit similar grants to others.

Another French company, the Societe Anonyme des Transportes Aeronautiques du Sud-Ouest, has been reconstituted under the title of Compagnie Franco-Bilbania des Transportes Aeronauticos, for the purpose of forming a Franco-Spanish company to open a service between Bayonne, San Sebastian, Bilbao and Santander, by which it is hoped to carry mails from Bilbao to connect with the Paris express at Bayonne, and, in the case of English mails, secure delivery in London on the following day by arrangement with the Paris-London air service. The com-

DAGUERREOTYPES were invented by Daguerre in 1839, but don't use one in applying for a position as long as

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pany would be registered in France in order to retain the right to the French air transport subsidies. A regular service between Nimes and Nice is conducted by the Compagnie, Aerienne Francaise, a flight being carried out in both directions bi-weekly. The company is subsidized under the government scheme.

The policy of carrying out long-distance flights in order to connect France with her colonial possessions by air is being actively pursued and a successful flight has been made across the Sahara from Algiers via Timbuktu to Kakar.

British Colonial Advances

The body which at present deals with aviation in Australia is a committee of the Prime Minister's Office, called the "Air Services Committee." No air regulations have as yet been drawn up by the Commonwealth Government, but it is understood that the whole question of the administration of civil aviation is now under consideration.

A number of demonstration flights are being conducted by ex-members of the Royal Air Force, and a gift of one hundred airplanes has been accepted from the British Government.

In Canada the Air Board Act was passed in January, 1919, instituting an Air Board consisting of not less than five and not more than seven members, to be appointed by the Governor-General in Council. The functions of the Board, which has been reconstituted under the chairmanship of the Minister of Militia and on which the Naval Service is represented, are similar to those of the Air Council of Great Britain. The Board includes a Superintendent of Flying Operations, responsible for all civil aviation undertaken by the Government, and a Superintendent of Certificates, who controls the licensing of personnel, aircraft and air harbors, and is responsible for civil aviation conducted by private enterprise.

The Associate Air Research Committee, which held its first Advisory Council for Scientific and Industrial Research, will work in close cooperation with the Air Board. The cooperation of the Meteorological Office and the General Superintendent, Government Radio Service, has also been secured.

Dangerous flying was prohibited by Order in Council on July 7, and regulations governing civil aviation, and based on the International Air Convention, were published on January 17, 1920.

The Air Board is giving consideration to the special use to which aircraft can be put in Canada, such as forest patrol and survey work; and authority has been obtained to carry out experiments in photo-topographical surveying in the province of Quebec.

The ban on civil aviation in India has been removed, and an Air Board has been set up under the administration of the Department of Commerce and Industry. Its functions are advisory, executive authority for carrying out its decisions being vested in the Department's Member in Council.

In New Zealand an act entitled "The Aviation Act of 1919" was passed in December, 1918, and empowers the Governor-General to make regulations by Order in Council as to the issue of licenses to flying schools and pilots, the registration of aircraft and prohibited areas.

Civil aviation in South Africa is temporarily under the control of the Department of Railways and Harbors, but on January 25, 1920, a conference was held to consider the best method of controlling and developing civil aviation in South Africa, and the whole question is now under consideration by the Union Government.

The Government is fully alive to the importance of aviation, and has already offered to take over the aerodromes on the Cairo to Cape Town route situated within its territory.

A strong combine of British firms is considering plans for the establishment of air services in the West Indies and Bermuda and its proposals are receiving the attention of the Colonial Governments concerned.

Holland Financing Long Distance Flights

Responsibility for civil aviation in Holland rests at present with the Minister of Waterways and Roads. A Dutch Air Attache has been appointed to Paris. As a means of awakening public interest in aviation in Holland and her colonies the Government has organized a long-distance flight from Holland to Java. It is defraying the expenses of the competitors, and subscribing 10,000 florins towards the prize.

The advantageous position of Holland as a junction for aircraft bound to Scandinavian countries is recognized, and subscriptions are being raised at several important industrial towns for the establishlishment of civil aerodromes. It is also believed that the Government has given, or contemplates giving, a grant to the municipal authorities of Amsterdam and Rotterdam for the construction of international aerodromes.

A company known as the Royal Air Transport Company for the Netherlands and Colonies, has been founded with the support of important commercial interests. This is a private company which has been granted the title of Royal by the Queen.

The Netherlands East Indian Government has decided, for purposes of meteorological, climatic, and other observations, to execute a daily flight between Batavia and Surbaya. This will be carried out during four months, not necessarily consecutive, and seaplanes and airplanes will be employed alternately.

Mail Service in Italy, Spain and Switzerland

In Italy the General Directorate of Aviation under the Minister of Transport, constituted by a royal decree of June 30, 1919, is still responsible for the administration of civil aviation, and controls the Technical, Supply and Experimental Departments of military aviation and training schools. It is, however, reported that the appointment of an Under-Secretary of State for Air is contemplated. A royal decree for the regulation of air navigation came into force on January 3, 1920. The Government is sparing no pains to promote Italian interest abroad, and it is estimated that 16 Air Attaches have been appointed to various countries. In addition to these, missions have been dispatched to Japan, Peru,

Poland, Serbia, Czecho-Slovakia, Finland, Indo-China and Turkey. As an example of the expenditure incurred in these missions, it is interesting to learn that the initial cost of the mission to Argentina was 6,000,000 lire, in addition to 350,000 lire a month for running expenses. Italy has also realized the importance of securing a market in the East, and for this purpose a demonstration flight has been made from Rome to Tokio. In connection with this flight a number of machines have been sent to China and are being exhibited at Shanghai.

A number of former service aerodromes have already been opened for civil aviation, and passenger and postal air service between Italy and Greece is being operated as an experiment by the Italian Government. A flight is made in both directions twice a week. Air postal flights have also been carried out by the Italians between Athens and Crete. With a view to advertising Italian machines a demonstration flight employing six seaplanes is expected to leave Naples for Sweden shortly. The development of air communication in the Italian colonies is also receiving attention. A service between Eritrea and Somaliland is being organized, while the possible use of air transport in Tripoli and the Libyan Provinces is under consideration. A feature of State aid is the proposed institution of civil aviation in schools and university courses at Rome and Turin. As an indication of the methods by which the Italian Government proposes to assist private enterprise, it may be mentioned that a Sardinian company is reported to have obtained a concession for running a service between Rome and Sardinia which includes a subsidy of 660,000 lire, and the free use of aviation material in Sardinia to the value of 15,000,000 lire.

The Ministry of Finance in Spain, under Royal Order, has fixed the rates to be paid for correspondence sent by air mail. Until special stamps are brought into use mail matter will be franked with the ordinary stamps surcharged according to the rate of the aerial post. All ordinary letters and money orders can be sent by aerial post, up to a weight limit of 500 grammes. Registered and insured letters and parcels are not carried and the Post Office accepts no responsibility for loss or damage. The technical inspection of air postal services will be conducted according to the regulations fixed for civil aviation, and an inspector for this duty will be appointed by the Director-General of Posts and Telegraphs. The air mail service between Barcelona and the Balearic Isles has been organized by an association of Mediterranean shipbuilders. It was inaugurated on March 18, 1920, and a preliminary flight has already been made. Italian seaplanes are to be used. A postal service between Barcelona, Alicante and Malaga has been authorized by the Director-General of Posts and Telegraphs, and inaugurated by the French Latecoere Company.

In Switzerland steps have been taken to dissociate the control of military and civil aviation, by transferring the latter from the Minister of War to the Minister of Posts and Railways, under whose administration a Bureau of Civil Navigation was opened on April 1st. This step has been hastened by the opening of the air traffic with England and France as a result of the temporary agreements with those countries, which came into force on March 1st. In the first instance, the Bureau will be provided with a small staff only and its duties will apparently be of a limited and tentative nature. Among its functions will probably be the supervision of examinations for pilots carried out by the Swiss Aero Club, and the encouragement of research. On January 27, 1920, the Government published Air Navigation Regulations governing flight over Swiss territory. The Swiss "National Aviatik" Company of Dubendorf has taken over from the Government the air service which formerly carried mails between Dubendorf, Berne, Lausanne and Geneva.

Promotion Work in the Far East

Foreign countries are continuing their endeavors to open up Chinese markets for their products, and in view of the predominant position which the French hold in the Chinese Postal Administration, it is not unlikely that they will make a strong bid for the privilege of inaugurating an air postal service. Italy is also making an effort to secure a footing, and a report was received towards the end of January, 1920, that a shipment of Italian airplanes had arrived at Shanghai, where the machines were on view. The Anglo-American Tobacco Company is reported to have decided to use airplanes to carry their men and medical supplies into the interior. An American company is reported to have shipped in January seaplanes to Hong Kong for operating commercially on the coast of China and adjacent waters.

In Japan, during the last six months, aviation has made little progress. There are signs, however, that the necessity for an efficient air service is recognized. A special committee has been appointed to deal with civil aviation, and it is expected that as a result of its deliberations, a permanent Aviation Board composed of eight representatives from the Army, four from the Navy and fourteen from the Civil Service will be established. The president of the Japanese Imperial Aviation Association is touring through Europe and America in order to make a thorough investigation of civil aviation. Two companies have been formed with the object of inaugurating air services.

South American States

Considerable interest in aviation is displayed by all the South American states. France, Italy, the United States and Great Britain are entering into keen competition to establish markets for their aircraft products. There exist at present three Air Transport companies: (a) The Compania Franco Argentina des Transportes Oereos, among the objects of which is to represent the French aviation industry in Argentina; (b) the Compania Argentina

ARTILLERY was invented by Schwartz in 1330. If your children are restless buy them a second-hand howitzer.

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des Transportes Aereos, which is closely associated with the firm of Sanez Mai and Company; (c) the Sociedad Rio Platense de Aviacion. A new mission from Italy (the second) arrived at Buenos Aires on March 29. This mission was sent by the Italian Ansaldo Company, and is composed of a number of pilots and mechanics, to be followed by some machines. The United States are represented by the Curtiss Aeroplane and Motor Corporation.

The French have obtained valuable contracts in Brazil, partly as a result of the efforts of their mission which was established in the country as far back as October, 1918, one of which is to equip and train the Brazilian Air Service. The Italians have also sent a mission to Brazil, but beyond carrying out propaganda it does not appear at present to have achieved any definite results.

Colombia offers exceptional opportunities for the employment of aerial transport, as throughout the greater part of the country the only other means of communication are the river Magdalena and a limited mule service. On April 11, 1919, a resolution, signed by the Minister of the Interior, was adopted, calling for public tenders for the transport of mails by air. The French have already obtained connections in this country, and in accordance with a contract entered into with the local Compania Colombiana de Navegacion Aerea (capital £160,000) have undertaken to send out an expert staff of pilots and mechanics to build suitable aerodromes and establish services between various towns.

Peru is very mountainous and offers but few places in which airplanes can land with safety. Seaplanes could be used to advantage as the coast is practically free from storms during the whole year. In August information was received that the Peruvian Postmaster had been authorized to ask for tenders from European and American firms to establish an air route between Tarma and Inquitos for the transportation of mail, passengers and freight.

Outlook in the United States

The creation of an Air Department has not yet materialized. Senator New's bill to effect this was discussed by Congress, but after meeting with considerable opposition, based on the expenditure involved, it was returned to the House Committee on Military Affairs for review and amendment. There is, however, growing recognition of the importance and great possibilities of civil aviation throughout the country, and in view of favorable factors such as long distances, an equable climate and financial prosperity, it is probable that civil aviation in the United States will develop quickly as soon as public confidence has been secured. A number of states and cities have brought forward independent measures for the regulation of civil air navigation. In this respect it appears that a lack of co-ordination of legislation may result as in the case with the United States motor laws. In the absence of Federal legislation, the United States Air Service has formulated rules of the air as a guide to pilots. A bill was introduced on February 26 in the State Assembly of New York to regulate the use of aircraft, and after first reading it was referred to the Committee of the Judiciary. Official effort is principally confined to the operation of mail service from New York to Washington and Chicago, for which the Post Office claims a considerable measure of success, and to the forest patrols. A number of air transport companies, such as the North American Aerial Transportation Company, are being formed and aircraft exhibitions have been held. The only noteworthy achievement overseas has been the inauguration in the Philippines of a daily mail service between Manila, Fort Mills and Santa Cruz. An aerial "Derby" around the world is now in course of organization and a special mission is touring the different countries for the purpose of making a preliminary plan. The mission has already visited Japan, China, Dutch East Indies, and French Indo-China.

MOSAIC OF MURRAY DAM

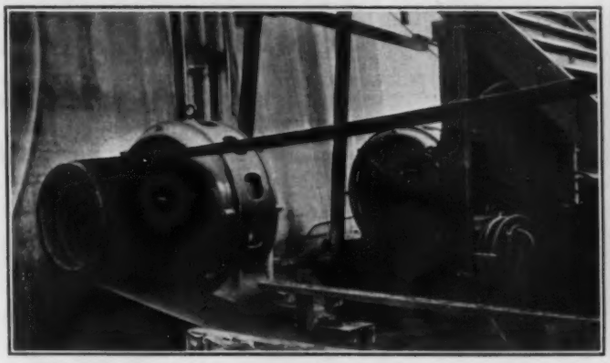
This remarkable picture of the Murray Dam, located just below the site of the famous old La Mesa Dam which was one of the early hydraulic fill dams of California, is made up from fifteen different airplane photographs taken from an altitude of 5200 feet. The Murray Dam is of the multiple arch type, 117 feet high, has a crest length of 900 feet and makes a reservoir of 6,750 acre-feet. These pictures were taken by Lt. L. W. Miller, U. S. Army, under the direction of Lt.-Col. H. B. S. Burwell, and the mosaic is reproduced here by the kindness of Colonel E. D. Fletcher of the Cuyamaca Water Company which owns the Murray Dam.

Trouble Shooting in Gold and Silver Mining

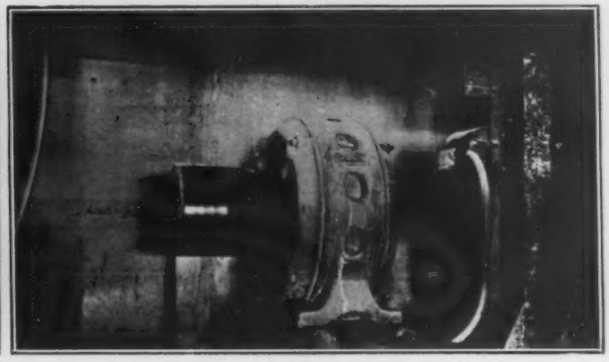
BY B. B. BECKETT

(Maintenance of equipment is a practical problem closely affecting the question of economy. Previous articles written by the same author, and published in the issues of March 15th and May 1st, treated of power requirements and choice of equipment respectively in the mining of precious metals. The following article deals with the prevention of time and labor losses resulting from failures of equipment, the principles being applicable of course to electric drive in any service. The author, now a consulting engineer, was formerly electrical engineer for the Goldfield Consolidated Mines, Nevada.—The Editor.)

Successful operation of electric drive equipment is chiefly a matter of preventing trouble. It is of first importance that the number of failures and also the total time lost be kept to a minimum, and yet it is peculiarly difficult to prevent failures in such service. The number of failures is, of course, dependent upon the severity of the conditions, but also varies directly with the number of hours in service, and it is to be remembered that most mill motors are in service 24 hours per day and every day in the year. It is difficult to give proper care when motors can be shut down only upon permission of the men whose duty it is to get the maximum production, and it is difficult to make proper repairs under the stress of hurry to get going again.



The two tube mill motors, Allis-Chalmers 200 hp., at the Goldfield Consolidated mill. The average load is about 220 hp., and the motor at the left has operated for eight years continuously without trouble.



One of the five stamp motors, Allis-Chalmers 60 hp., at the Goldfield Consolidated mill. These are underneath the ore bins in a dark and very dusty location, but operate under an average load of 42 hp., giving very little trouble.

At Goldfield, failures averaged four or five per month out of about 110 motors connected. Of these, only about one in four was a shop job, that is, so serious that the motor was sent to the shop for rewinding. This number of failures is high, due to the fact that most of these motors were old and had been several times repaired. In good average practice, with modern equipment, half this number may be expected.

Failures in starters are almost as common as motor failures but of much less consequence. The great majority are contact troubles that are readily repaired. There were a number of starter burn-outs in Goldfield, due usually to starters being left on starting position, but this is rare with modern starters having spring handles.

Failures of transformers are very rare. There is only one other class of failures common enough to require mention here, viz., open lines, due almost always to local heating resulting from high contact resistance at some bolted or spring held terminal. These are very readily repaired when found, but are often very puzzling to find and for this reason may cause several hours' delay. They are important also because they sometimes result in motor burn-out by leaving the motor running single-phase.

Spare Equipment and Parts

It is good practice to carry spare motors for all small motors, up to 100 hp., and a complete set of spare coils for larger motors doing essential duty. One spare motor will serve for a number of the same or slightly smaller size up to some six or eight, and beyond that another spare should be provided. Spare coils also should be provided when one motor is serving for as many as six, as the loss of one would leave the others uncovered until the first is re-wound. Regarding spare bearings, these are of doubtful value as a burnt-out bearing usually means a burnt-out motor, or one so damaged that the bearing can be re-babbitted while the motor is being repaired, and hence without additional loss of time. It was once the practice to carry spare rotor bars. This is not worth the cost, even with bolted construction. It is not usual to carry spare laminations, as cases are rather rare where laminations are damaged so badly that they cannot be used again after separating and restacking. Spares need not be carried for hoist motors, as these, being always under control, are rarely damaged beyond a few coils, which can be cut out.

DYNAMITE was invented by Nobel in 1867. Don't keep it stored in the basement; somebody can use it.

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Starter contact parts should always be carried, as many as necessary to insure always having a supply on hand. Spare transformers or parts are not recommended, except in extreme cases, as when transformers are dangerously overloaded already.

Causes of Failures

Based upon our experience at Goldfield, the more common causes of motor failures are given in the order of their importance in the following table:

1. Vibration, or shaking.
2. Dirt in oil.
3. Water on winding.
4. Overload.
5. Loss of one line connection (single-phasing).
6. Original defect.

These are the primary causes. Ultimate failure is usually due to a succession of events, and often a secondary cause is blamed whereas the trouble could have been prevented only by removing the primary cause. For instance, vibration may cause bearing enlargement permitting rotor to rub stator, which will burn insulation, eventually causing failure by ground or short. Vibration, the most prolific trouble maker, may result from the following conditions:

1. Gear drive.
2. Unbalanced pulley.
3. Badly spliced belt.
4. Unbalanced rotor.
5. Connected or adjacent machines.

The most destructive form of vibration is not a visible shake but a fine sharp buzz that can be best detected with the finger nails or with a steel against the teeth. It may cause:—

1. Broken connections in stator or wound rotor.
2. Broken rotor bars.
3. Broken main frames.
4. Bearing enlarged by constant rubbing.
5. Oil thrown out by splatter.
6. Oil plug shaken loose and out.
7. Bearing set screw out, permitting bearing to turn.
8. Oil ring, if split type, shaken apart.
9. Oil soaked windings.
10. Sparking at slip rings and commutator.
11. Rotor core bolts loose or broken.

These are only the immediate results, as each may lead to something else. For instance, a broken connection may result simply in a trouble call and quick repair, but it may also result in a badly scorched winding if the motor continues to run on single phase. Broken rotor bars are of little consequence as a rule, but if many bars are out of place, the resultant unbalanced magnetic pull may be powerful enough to draw the rotor over against the stator, thus burning laminations and coils. Bearing troubles due to vibration have about the same results as if due to dirt in the oil, the second most common primary cause listed above. This may be merely renewal of babbitt at convenience, but may be babbitt melted out and motor stalled, or rotor allowed to drag on stator until burn-out follows. Oil on windings, besides being objectionable from the standpoint of cleanliness, is itself a common cause of motor failure. It collects dirt, raising the temperature by impeding ventilation, and it dissolves out the insulating varnishes, aiding the entrance of moisture. If copious, it loosens the coils so that they move constantly and rub against each other until the insulation is worn through.

Sparking, besides causing rapid wear of brushes and rings or commutator, may fill the winding with carbon dust until bad flashing occurs, sometimes accompanied with destructive arcing between exposed terminals or coil ends.

Water on windings is not as serious as it sounds. If there is any damage at all, it is usually a simple ground or short which can be quickly repaired. In case of complete soaking, it is, of course, necessary to dry out the motor, else it may be entirely burnt out by distributed leakage. The delay for drying is usually the worst result.

Overload seldom causes immediate failure. If accidental and severe, it will usually open protective devices. More often the winding is repeatedly scorched, or gradually carbonized by carrying just a little too much, until failure finally results from distributed leakage. A complete new winding is then required.

Single-phasing, as it is sometimes called, does no harm if the load is not more than about 60% of what the motor would carry normally; and if more, then the effect is that of an overload. It results from one line connection becoming open somewhere, usually in the starter contacts, often at a terminal lug that has heated up from high contact resistance, and sometimes it results from the blowing of a single fuse. This last is also often due to heating of terminals from high contact resistance.

Original defects in motors, such as poorly soldered connections, insulation torn at edge of slot when coil was forced in, etc., do not always show up at first but stand until developed by some other primary cause, as vibration or overload. They are rare.

All of the troubles and causes listed above were actually encountered at Goldfield in one or more instances, and the writer has had experience of many of them elsewhere. Bearing troubles of one sort or another are the most frequent, constituting more than half of all motor troubles, and are also the most destructive, since they so often result in rubbing in the air gap. This is the worst thing that can happen to a motor as it damages both coils and laminations. Many re-wound motors are below par because their laminations have been injured and not replaced.

Inspection

In any large mill, the electrician should make a regular routine inspection every morning, with motors running, and should arrange for a shut-down for more complete inspection and cleaning of each motor and starter every ten days or two weeks. The daily routine inspection may be omitted for motors seldom used and those having special attendance as hoist motors and pump station motors. In this inspection, motors should be examined for temperature, hot bearings, oil conditions, vibration, and as to danger from dripping or splattering water and water brought up by the belt. The last two, when they cannot be corrected by the man on shift, should be reported to the superintendent, and if not promptly corrected, should be reported in writing. At the more careful inspection, when motors are shut down, the air gap should be gaged by means of a set of

steel gages of several different thicknesses and a record kept in a note book, or on special forms, of the clearance in the air gap, top, bottom, and each side. By keeping a continuous record of each motor, it will be possible to note the progress of wear and thus determine when bearings should be renewed. For appearance sake, motors should be wiped off on the outside, but no attempt should be made to clean them internally except when in the shop for repairs, or when so badly choked with dirt that ventilation is reduced to such a degree as to cause dangerous temperature rise. The practice of blowing out motors periodically with compressed air is not good, as air frequently contains moisture, and also dirt is sometimes blown into bearings or into parts of the winding where it will do more harm than before. Dry dust on a motor, if the bearings are protected, is quite harmless; and if caked on with oil from leaking bearings, it can only be removed effectually in the shop.

Starters should be examined at the same time as the corresponding motors and their contacts filed smooth or renewed. The oil in starters requires little attention except to see that it covers all contacts and that the mud in the bottom is not deep enough to touch conducting parts. The low voltage release should be kept clean so that it does not stick.

Transformers and oil switches other than starters should be inspected twice a year, mainly to see that the oil is at proper level, that is, covering all exposed terminals and connection boards. In the case of high tension transformers, 15 kv. and over, the oil should be examined also for moisture and carbon.

Occasionally all switch lugs and unsoldered contacts carrying heavy currents should be examined for high temperature, as they are always liable gradually to heat up from oxidation even though they have been in service for years. This is particularly true of switches and fuses that are rarely opened. Use tends to break the oxide film. Moisture seems to have a similar effect, and oil or grease on contacts tends to prevent oxidation by excluding air. Many blown fuses are the result of contact heating. The inspection should be made by a responsible man, not left to a mere helper.

Lubrication

Any good mineral oil is satisfactory for motor use, provided it is clean, is thick enough not to be thrown by the rings, and thin enough to flow freely at normal temperature. In general, large bearings require heavier oil than small ones. If the oil is too stiff, the bearing will warm up to a point where the oil will be thin. If the rings are throwing the oil by running too fast, this may be stopped by using a heavier oil. But this throwing of oil may be due to a bent ring, or to vibration. Whatever the cause, it should be stopped if possible, for the flying drops of oil, although caught by the housing, will usually crawl to the edge and saturate the dust guard, if there is one, or drip down on to the shaft. The menace to the bearings from loss of oil may be nothing, but this oil will usually get into the winding, either along the shaft or by flying in with the draft of air from the under edge of the housing. A few drops a day will eventually saturate the winding.

The practice of oiling motors every little while, whether needed or not, and particularly through the covers, is very bad though all too common. Oil should be put in only through the oil gage, and never without ascertaining the cause of its being low and correcting it if possible; for oil does not dry up or wear out. If low, it must have leaked out and probably has gone into the winding. If a bearing is running properly, it need never be touched and need never have a drop of oil added, not within the ordinary life of machines. Putting oil in through the cover is almost certain to result in getting dirt in on the bearings. In cases where operators cannot be taught to refrain from doing this, the covers should be wired down. The cover is for inspection, and when the fact has once been ascertained that the rings always start and run properly, the cover need never be raised.

Barr bearings have been advocated as a means of preventing bearing troubles, particularly rubbing in the air gap. The writer's experience is not sufficient on this point except to indicate that ball bearings are quite as sensitive to dirt and to vibration as are babbitt bearings. They do prevent the oil nuisance and probably would reduce the number of cases of rubbing.

FEDERAL POWER COMMISSION ORGANIZATION

The newly created Federal Power Commission plans, among other things, to compile improved statistics concerning water-power resources, their utilization and distribution. This work will be done in cooperation with the electrical industry and with the public utility commissions of the various states.

Geographical divisions of operation under the Federal Power Commission

The heads of divisions into which the Federal Commission is divided are to be known as chief engineer, chief accountant, chief counsel, and chief clerk.

ELECTRIC ARC LIGHTS were invented by Davy about 1830. If you can't see your way to getting what you want,

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Air Draft Required for Fuel Oil

BY ROBERT SIBLEY AND C. H. DELANY

(Is the actual draft available in your steam power plant sufficient to bring about the greatest economy? Here are some recent research notations on this important and timely problem by the authors of the text book entitled "Elements of Fuel Oil and Steam Engineering," which is soon to make its second appearance on the market, greatly enlarged and illustrated with over two hundred distinct charts, photographs and diagrams. This second edition is being published by McGraw-Hill Book Company, New York City.—The Editor.)

For every kind of fuel and rate of combustion there is a certain draft with which the best general results are obtained. A comparatively light draft is best for burning bituminous coals and the amount to use increases as the percentage of volatile matter diminishes and the fixed carbon increases, being highest for the small sizes of anthracites. Numerous other factors such as the thickness of fires, the percentage of ash and the air spaces in the grates bear directly on this question of the draft best suited to a given combustion rate.

For fuel oil, the question of draft required is greatly simplified by the fact that the air does not have to be drawn in through a thick bed of fuel and there are no ashes or clinkers to further complicate the matter. The resistance offered to the entrance of air to the furnace is caused by the checkerwork furnace floor, and as the openings in the checkerwork can be altered at will, it is evident that the amount of draft required in the furnace will depend largely on the arrangement of checkerwork adopted.

For a furnace arrangement in which the total net area of free air space amounts to 3 to 3½ sq. in. per rated horsepower of the boiler, the draft required in the furnace amounts to the following, approximately:

Per cent of rating	Draft in furnace
100	0.05
150	0.10
200	0.25

The draft in the furnace is only a small proportion of the total draft that must be supplied by the chimney, for it is necessary to add to the furnace draft the draft loss caused by the friction of the gases in passing through the boilers, breechings and flues leading to the chimney.

Draft Losses in Steam Power Generation

The loss of draft is greatest in boilers having the longest path of gases, the greatest velocity, and the greatest number of changes in direction of flow of gases. A boiler having a single pass with the hot gases entering at the bottom and leaving at the top has a minimum draft loss. In most designs of boilers, however, this arrangement cannot be adopted as the area of gas passage would be too large. This would result in the gases short circuiting, that is passing in a narrow stream from one corner to the other without coming in contact with all of the heating surface. To make the heating surface effective in absorbing heat from the gases it is therefore necessary to provide baffles in the boiler, which deflect the gases and cause them to travel back and forth until their temperature has been reduced as much as possible.

The arrangement of baffles is a feature of boiler design and need not be entered into here. It is well, however, to refer briefly to the general principle involved, namely, that the higher the velocity of gases traveling over the heating surface the greater will be the coefficient of heat transfer. Consequently it would seem that in order to insure maximum efficiency of the boiler there should be a large number of passages of small area, so as to insure high velocity of the gases. This is true up to certain limits, but unfortunately it is soon found that the additional loss of draft caused by increased friction and extra changes in direction of the gases makes the production of the required draft both difficult and expensive.

In the majority of water tube boilers the baffles are arranged for three passes, that is the gases are forced to travel the length or height of the boiler setting three times before reaching the stack. With this arrangement the areas of passes are such as to give the gases a velocity of 10 or 15 ft. per second when the boiler is operating at its rated capacity. By increasing the number of passes to four or five the velocity may be increased to 20 or 30 ft. per second. This results in a higher rate of heat transmission so that more heat is absorbed from the gases, reducing their temperature and resulting in less waste to the chimney.

To enable the number of passes in a boiler to be increased the chimney must be designed to suit the increased loss of draft that will occur. Thus in every case the actual draft loss should be determined as closely as possible, and the actual figures for the particular case in hand used in designing the chimney. It is desirable in all cases to design the stack for a greater draft than is expected, for it is a simple matter to reduce the draft by closing in on the damper, whereas if the draft is insufficient nothing can be done to increase it. Again, it may be desired at some future time to increase the number of passes in the boiler, or otherwise modify the baffles in such a way as to require more draft. This would be impracticable unless the stack is large enough to produce a surplus of draft.

In order to give the reader some general ideas of computations involved in ascertaining draft losses assumed in design we shall now pass to a brief consideration of this problem.

Loss of Draft in Boilers.—The loss of draft through a boiler proper will depend upon its type and baffling, and will increase with the per cent of rating at which it is run. For design purposes, it may be assumed that the loss through an oil fired boiler between the furnace and the damper will be 0.15 in. when it is run at its rating, 0.35 in. at 150

per cent of its rating and 0.60 in. at 200 per cent of its rating.

Losses in Flues and Turns.—With circular steel flues of approximately the same size as the stack or when reduced proportionally to the volume of gases they are to handle, a convenient rule is to allow 0.1 in. draft loss per 100 ft. of flue length and 0.05 in. for each right angle turn. These figures are also good for square or rectangular steel flues with areas sufficiently large to provide against excessive frictional loss. For losses in brick or concrete flues these figures should be doubled.

Thus the loss in draft flues and turns for an installation having a flue 100 ft. long and containing two right angle turns is

Loss for flues, per 100 ft.	0.1 in.
Turns 2 × 0.05	0.1 in.
	0.2 in. loss

Total Available Draft Required.—We are now enabled to compute the total available draft required for a boiler installation by summing up the separate components required for the furnace, for the boiler, for the flues and for the turns.

Thus, for an oil fired boiler to operate at 200 per cent of its rated capacity, connected to a chimney through a flue 100 ft. long and containing two right angle turns, we have the following:

Draft in furnace	0.25 in.
Draft loss in boiler	0.60 in.
Draft loss in flue	0.20 in.
Draft required at base of chimney	1.05 in.

Artificial Draft.—As we have seen draft in a stack is caused by difference in pressure between the gases inside and outside, resulting in a flow of air from the higher external pressure to the lower internal pressure. A similar difference in pressure, and consequent flow of air, may be produced by a fan or blower instead of by a chimney. When this is done we have what is known as Artificial Draft.

There are two forms of artificial draft known as Forced Draft and Induced Draft, the distinguishing feature between the two being the location of the fan in respect to the boiler.

In the case of Forced Draft the fan sucks air direct from the atmosphere and delivers it to the boiler, under pressure somewhat greater than that of the atmosphere. In the case of Induced Draft the fan is located between the boiler and the stack, sucks the gases of combustion out of the boiler and discharges them to the stack.

Since Forced Draft produces a pressure greater than atmospheric, its use is confined principally to forcing air through a thick bed of fuel on the grates. It is used largely in connection with certain kinds of stokers, and frequently with hand fired boilers using low grade coals. Forced draft is not suitable for steam atomized oil-fired boilers, because there being no fuel belt on the grates to offer resistance, the positive pressure from the fan discharge would be carried up into the boiler setting. This would cause the gases to leak out into the boiler room, and in some cases would result in excessive furnace temperature and burning out of the brickwork. For satisfactory operation of stationary boilers it is necessary to keep the pressure of the gases within the boiler setting slightly lower than atmospheric pressure. When forced draft is used the positive pressure should not extend past the ash pit. Forced draft is used extensively with Mechanical Atomizing oil burners, where owing to the small area for air admission it is impossible to get into the furnace enough air for high overloads by means of natural draft.

Induced draft can be used instead of natural draft wherever desired. It is cheaper to install than a high stack, but the power required to drive the fan makes it more expensive to operate. It is of especial advantage where the gases escaping from the boiler are passed through an economizer to absorb some of their heat, before they are allowed to reach the chimney. The economizer introduces added frictional resistance to the gases so that extra draft is required. Besides this, the economizer reduces the temperature of the gases to such an extent that to obtain sufficient draft without a fan would require a stack of excessive height. By installing an induced draft between the economizer and the stack, ample draft can be obtained regardless of the height of the stack or the temperature of the gases.

Induced draft is also of value, even when economizers are not employed, in cases where it is impracticable or undesirable to build a stack of normal height. An example of this is found in the power plant of the University of California, where a high unsightly stack would seriously interfere with the architectural features of the university buildings. By building a stack only 50 ft. high, and supplementing it with an induced draft fan, this difficulty was overcome.

AN AMERICAN GOLD DREDGE FOR NEW ZEALAND FIELDS

An example of the far-reaching activities of American industry is to be found in a gold dredge that has been designed and constructed in New York for the purpose of operating in New Zealand gold fields. This dredge is being built by the New York Engineering Company and is along the type of dredge constructed for operations in Alaskan fields. The hull is 115 feet 6 inches overall, beam 50 feet, depth 11 feet, and is built of Kauric pine. Power for dredging, pumping and shifting position is furnished by Westinghouse electric motors, while twelve men, four men to a shift, constitute the crew.

Dredges of this type have operated on a cost basis of 6½ cents per cu. yd. and in one instance where records are available, 418,745 cu. yds. have been dug in a period of two years.

AIR BALLOONS were invented by Gusmac in 1729. If you are up in the air try advertising for a position:

THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

Problem Course in Electricity

BY H. H. BLISS

(The toaster on your breakfast table converts electrical energy into heat. The simple mathematical processes by which you can figure the amount of energy required to produce a given amount of heat or mechanical energy, are described below in the seventh of a series of practical articles. The author is on the staff of the Riverside Junior College at Riverside, California.—The Editor.)

TRANSFORMATION OF ENERGY

Kilowatt-hours and Horsepower-hours.—If the motor in Fig. A absorbs 5 kw., the lamps take 1400 watts, and the line loss is 600 watts, what is the output of the generator in 3 hours? The **power** output is evidently 7 kw., whether the generator works one minute or 24 hours, but the amount of electrical **energy** it supplies to the circuit depends upon the time. We say that 7 kw. for 3 hours makes

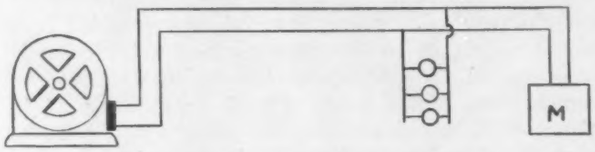


Fig. A. Diagram of circuit including generator, motor and lamps, illustrating calculations for transformation of energy.

a total of **21 "kilowatt-hours"** (abbreviated "kw-hrs."), defining one kw-hr. as the energy supplied in one hour if the power is one kw. The rule is: **"No. of kw-hrs. = no. of kw. × no. of hours"** (provided the power is constant or uniform during the time).

What is the output of the motor in the same figure if its efficiency is 90%? The **power** output is $5 \times .90 = 4.5$ kw. $= 6$ hp., and the **energy** output, or work done, is $6 \times 3 = 18$ **"horsepower-hours,"** where the definition is analogous to that above.

It is to be noted that we multiply power by time to get a measure of the energy used up or work done, and it is this, rather than the power, for which we are charged in a bill for electric current. What is the value of the energy lost in transmission in the preceding example, if it costs the power company 2 cents to generate 1 kw-hr.? $600 \times 3 = 1800$ "watt-hours" $= 1.8$ kw-hr. Then $1.8 \times 2 =$ **3.6 cents.**

Since it is energy and not power that is paid for, the meter used is not a "wattmeter" but a "watt-hour meter," an entirely different instrument. What is the meter reading and the cost for a month if a family uses six 40-watt lamps 4 hours a day and the price of energy is 8 cents per kw-hr.? $6 \times 40 \times 4 = 960$ watt-hours per day; $30 \times .96 = 28.8$ **kw-hrs.** Cost $= 28.8 \times .08 =$ **$2.30.**

Mechanical Energy.—If a one-hp. engine operates for one second it is able to lift 550 lbs. one foot vertically. This amount of work we might call one "horsepower-second." It is more often designated as 550 "foot-pounds," where one foot-pound is the work of lifting a pound weight one foot (or moving any object for a distance of one foot against a resistance of one pound). This is, then, a simple and direct unit for the measure of mechanical energy.

One hp. is 550 ft. lbs. per second. A "horsepower-minute" $= 60 \times 550 = 33{,}000$ ft. lbs.; a horsepower-hour $= 60 \times 33{,}000 = 1{,}980{,}000$ ft. lbs. Then one kw-hr. $= 4/3$ of this, or 2,650,000 ft. lbs.

The motor in Fig. B is 85% efficient; it lifts a mine hoist weighing 2000 lbs. a distance of 1400 ft. What is the cost of electric energy consumed, at 4 cents per kw-hr.? $2000 \times 1400/.85 = 3{,}300{,}000$ ft. lbs. = input to motor. $3{,}300{,}000/2{,}650{,}000 = 1.25$ kw-hr., costing **5 cents.**

Electricity and Heat.—Whenever current flows through a conductor it produces heat therein. The heat either raises the temperature of the conductor or escapes to the surrounding material. This is often practically useful, for it forms the basis of all electric heating, lighting, cooking, welding, etc. The enormous use of electricity for lighting is largely responsible for the rapid expansion of the electrical industry.

It is well to note that there is a distinction between "heat" and "temperature." A hot body may contain less heat than one much cooler, as will be

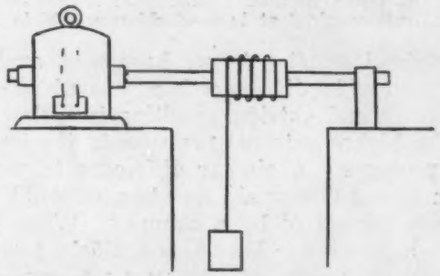


Fig. B. With a motor 85% efficient lifting a mine hoist weighing 2000 lbs. a distance of 1400 ft., what is the cost of electric energy consumed, at 4 cents per kw-hr.?

seen by comparing the heat necessary to bring a cupful of cold water to the boiling point with the heat necessary to raise a tubful of cold water to the temperature of a hot bath. A thermometer will show the cupful of water to be **hotter,** but the gas meter will indicate that tubful took far more heat.

Heat is one form of energy and hence can be measured in such energy units as foot-pounds or kw-hrs. The simplest unit is, however, the "B.t.u." or "British thermal unit," which is the heat required to make one pound of water one degree warmer. What heat is necessary to bring a tubful of water (say 300 lbs.) from 60° to 100° Fahr.? It takes 40 B.t.u. to warm one lb. of water by 40° (60 to 100); $300 \times 40 =$ **12,000 B.t.u.**

Calculating Heat Developed.—Numerous tests have shown that when mechanical energy is converted into heat by friction, one B.t.u. is developed for every 777 ft. lbs. used up. Hence one hp-hr. would produce $1{,}980{,}000/777 = 2545$ B.t.u.; one

kw-hr. gives 4/3 as much, or 3412 B.t.u. These figures make it very simple to calculate how much heat will appear for any given loss of mechanical or electrical energy.

For example: A certain electrical device known as a "transformer" may have an efficiency of 95%. Coils of pipe carrying water are used to remove the heat developed by the electrical losses. How many B.t.u. are taken by the water in 60 hours if the input to the transformer is 8 kw.? Loss = 5% of 8 = .4 kw.; 60 × .4 = 24 kw-hrs. This = 24 × 3412 = **82,000 B.t.u.** If 1300 lbs. of water at 50° Fahr. enters the system during this time, what is the temperature as it leaves? Since the number of B.t.u. = lbs. × degrees rise, the rise = B.t.u./lbs. = 82000/1300 = 63°. Final temperature = 50 + 63 = **113°.**

Transformation of Energy.—As in the example above, electrical energy is readily turned into heat. So also is mechanical energy, as in all cases of friction. It is more difficult to change heat energy into one of the other forms, yet it is often done, by means of such "prime movers" as the gasoline engine and the steam turbine. It is found in all such cases that a large portion of the heat energy (60 to 90%) cannot be converted, but remains as heat, while the remainder is turned into mechanical energy, and possibly later (by means of a generator) into electrical energy.

A gas engine of 25% efficiency uses fuel enough to supply 1,535,000 B.t.u. The engine is "direct connected" to a 120-volt d.c. generator of 80% efficiency. How many kw-hrs. does the generator give out, and what is the average current, if the fuel is burned in 5 hours?

The energy in the fuel = 1,535,000 B.t.u.; 1,535,000 ÷ 3,412 = 450 kw-hrs.; 25% of this = 112.5 kw-hrs. which the engine gives to the generator. Then 80% of 112.5 = **90 kw-hrs.** which the generator gives out. If this is given in 5 hours, the average power is 90 ÷ 5 = 18 kw. = 18,000 watts. Current = watts/volts = 18,000/120 = **150 amperes.**

Tests show that it requires only about .02 of a B.t.u. to heat one cubic foot of air one degree. What is the cost of warming a room 12 x 15 x 9 ft. from 30° to 65° F. by electricity costing 6 cents per kw-hr.? The cubic feet = 1620, which could be warmed 1° by 32.4 B.t.u. Heat required = 35 × 32.4 = 1133 B.t.u. which equals 1133/3412 = .33 kw-hrs. Hence the cost is **2 cents.**

Solutions of Problems of Previous Set

61. 30/15 = 2 amperes = current; hence loop resistance is **9 ohms**, and each wire has **4.5 ohms.** The load takes 60 watts; line loss = 2 × 2 × 9 = **36 watts.** Power delivered by battery = 96 watts, and efficiency of line = 60/96 = 62.5%.

62. 15 × 2.6 = **39 volts drop.** Watt loss = 39 × 15 = **585 watts.** 110 — 39 = 71; 71 × 15 = **1065 watts** in arc.

63. When 30 volts are applied the total current is 10 amperes; that through the heater is 2.5 amperes. Resistance of coil = 30/7.5 = **4 ohms.** Power taken = **300 watts.**

64. Loss = amperes × amperes × ohms = 14 × 14 × .56 = **110 watts.**

65. Loss in "armature" = **10 watts, 40 watts,** and **90 watts** in the three cases. Loss in "field" = **64 watts.**

66. Input = volts × total amperes = 32 × 22 = **704 watts;** output = input — losses = 704 — 40 — 64 — 150 = **450 watts;** efficiency = **64%.**

67. The total resistance = 50 + 165 + 9 = 224 ohms; current through transmitter = **.116 ampere.** Current in one winding = .116/2 = .058 ampere; power = .058 × .058 × 18 = **.06 watt.**

68. Lamp resistance = 111.2/7.2 = 15.44 ohms. Adding line resistance (between generator and lamps) makes the total circuit resistance = 15.7, hence the current = 116.7/15.7 = 7.44 amperes. Drop in line = 7.44 × .26 = 1.93 volts, leaving **114.8 volts** at lamps. Line loss = 1.93 × 7.44 = **14.4 watts.**

69. The heater loop has 50 × .002 = .1 ohm, so that this branch has a total of 1.2 ohms. The combined resistance of the two branches is found by assuming one volt across JK: 1/1.2 = .8333; 1/6 = .1667; sum = 1.000 ampere: hence combined resistance = 1 ÷ 1 = 1 ohm. Add the resistance of the other loop (100 × .002 = .2 ohm) and total circuit resistance = **1.2 ohms.**

70. Current from battery = 30/1.2 = **25 amperes** = current in the 50 ft. wires; drop = .2 × 25 = 5 volts, leaving **25 volts** at junction. Current through heater loop = 25/1.2 = 20.82 amperes. Drop = 20.82 × .1 = 2.08 volts; at heater voltage = 25 — 2.08 = **22.92 volts.** Loss in each 50 ft. wire = volts drop × current = 2.5 × 25 = **62.5 watts;** in each 25 ft. wire loss = 1.04 × 20.82 = **21.6 watts.**

71. 30,000/550 = **54.5 hp.**

72. Speed = 15 × 5380/2600 = 22 ft. per sec. Then 500 × 22/550 = **20 hp.** ¾ of 20 = **15 kw.** = **15,000 watts.**

73. Since No. hp. = lbs. × ft./(550 × secs.), the lbs. = hp. × 550 × secs./ft. = 26 × 550 × 300/110 = 39,000. Gallons = 39,000/8.3 = **4700.**

74. The input to pump = 26/.65 = 40 hp. The input to the motor = 40/.86 = **46.5 hp.** = **35 kw.**

75. Input to motor = 4/3 of 30 = 40 hp. Output = 40 × .90 = 36 hp. Only 86% is applied to cages: 36 × .86 = **31 hp.**

76. The cages constitute a net load of 3300 — 1600 = 1700 lbs. Since hp. = force × speed/550, speed = 550 × hp./force = 550 × 31/1700 = **10 ft. per sec.**

77. Output of locomotive = 1200 × 5 × 5280/(550 × 3600) = 16 hp. = 12 kw. Input = 12/.65 = 18.5 kw. Amperes = 18500/84 = **220 amperes.**

Problems on Energy Transformation

78. A motor of 92% efficiency, with an input of 250 hp., drives a mine pump which lifts 1000 gallons per minute to a height of 660 ft. Find efficiency of pump.

79. The resistance of the loop between a generator and a motor is 3 ohms (total). The motor input is 5700 watts; the generator delivers 6 kw. to the line. Find line loss and current flowing.

80. What is the hp. output of a gas engine which has 32% efficiency, if it uses in 20 hours fuel enough to produce 2,300,000 B.t.u.?

81. A 100-hp. motor of 90% efficiency drives a ventilating blower 8 hours at a cost for current of $14.60. What is the price of electric energy?

82. How many B.t.u. per hour are developed by an electric hot plate taking 4 amperes on a 220-volt circuit? If half the heat escapes to the air how hot will 8 lbs. of water get in half an hour, if its temperature is 60° when set upon the hot plate?

83. How many gallons of cooling water per hour will be warmed from 60 to 100° Fahr. in a 1000-kw. transformer of 97% efficiency,

84. A 35-hp. motor hauls a loaded car at 3.5 ft. per second up a 40° slope to a coal bunker. Find the weight of the loaded car, the pull being 70% of the weight.

85. With a motor of 60% efficiency, how many ft. lbs. of work will be done on $4.50 worth of energy at 5 cents per kw-hr.?

86. A 600-watt electric heater operates for ten minutes in a bath room 6 x 8 x 8 feet in size. The air is at 50° Fahr. at the beginning; what is its final temperature if all the heat remains in the air?

INCANDESCENT LAMPS were invented in 1879. If you need more light on the subject of supplies

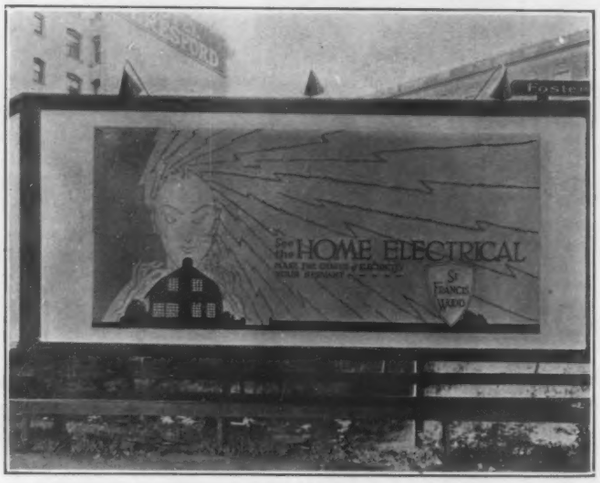
THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

Advertising

BY HOWARD ANGUS

(The stranger in the city is not on your mailing list, and perhaps does not see the newspaper; how can you introduce your store to him? In this concluding article of his series on advertising, the secretary of the California Electrical Cooperative Campaign discusses sign advertising and store display as publicity methods.—The Editor.)

Those among you who are large electrical contractors and dealers can use bill boards with good effect. This means of advertising is probably too expensive for the average electrical contractor and dealer, even though it is effective. It is quite possible, however, for all electrical contractors and



The billboard shown above was most successful in attracting the attention of the unobservant crowd to the recent San Francisco electrical home.

dealers in any city to band together and use billboards effectively. This will sell the electrical idea in a cooperative manner and will indirectly secure results to the individual contractor and dealer.

The Use of Billboards

The most important feature of a billboard is its location, for again it is readers you are after. The ideal location of course is on some principal highway leading into the city over which there is a great deal of traffic, preferably on a curve, so that the sign faces the people as they come up the road. The same principles apply to a good billboard as to a newspaper advertisement with the addition that it should have striking and distinctive colors and a unique appearance. A billboard, especially one owned by an electrical contractor-dealer, should be illuminated at night, not only for the advertising value of the board during the dark hours but also to sell illumination to the public.

What has been said of billboard advertising applies equally to street car posters.

A fine medium of advertising is your delivery wagon. These should all carry advertisements telling what you have to sell, how desirable it is, and where your store is. These statements should be short and to the point and in extra large letters, because delivery wagons pass rapidly. You ought to have several signs and change them frequently, because you have more than one article to sell. If possible have the body of your delivery wagon in some unusual design. That always attracts attention and interest.

An electrical contractor should always have a sign on every house he is wiring, telling those who pass his firm name, store address and telephone number.

Electric Signs

You should by all means have an electric sign. For you not to have an electric sign is the same thing as an automobile man without an automobile, a grocer refusing to eat, or a clothing merchant not wearing clothes. An electric sign typifies your business so perfectly that it is a necessity and should set the example for the city.

An electric sign is of great advertising value. While it is difficult to estimate the number of people an electric sign will bring to your store, all of them have always resulted in more sales. The big advantage of the electric sign is its appeal to people at night. The streets are always filled with people in the evening who are either shopping, going to or from some entertainment or otherwise on pleasure bent. At this time their minds are relaxed and they are in a receptive mood and particularly impressionable. The four features of an electric sign, generally speaking, are: motion, color, uniqueness and a message. An electric sign always receives attention and arouses interest, but to awaken a desire and action it must tell a story briefly by picture or word, preferably both.

Store Display

Your store display is part of your advertising. Your appliances neatly and temptingly arranged in show cases, on the display tables and on the floor, your fixture room—all should call the attention of any person in your store to other articles in such a manner as to awaken their attention and interest. The subject of store display is too large to be even attempted in this article. It is mentioned, however, that you may understand that there are reasons for an attractive, clean and neat store display and that one of those reasons is advertising and selling value.

There should be unity in all your advertising. Your windows should show what you have advertised in the newspapers or on the billboards or in the street cars or sent out in circular letters, and all should tie-in with the advertising of your manufacturers in the national magazines.

Civic Interest

Any activity on your part in assisting your city to grow will help your business.

Every merchant in every city should be interested and take an active part in all organizations and movements that have for their purpose the growth

and development of his city. This work has a very definite effect on his store. First, the larger his city becomes the more business there will be for him to do, and secondly, it has a distinct advertising feature. The more he moves and works among his fellow men, the better known he becomes. The more intimately his activities become connected with those tending to make the city grow and become prosperous, the more often his name appears in the newspaper and the more people come to know of him by reputation. This advertising is of the highest value, for people think of their prominent men as reliable and worthy of confidence. The certain result is more business for the store. A study of the leading merchants of your city will convince you of this fact. And what is good business for them, is good business for you. Many contractors and dealers have realized that important fact. More should. It will help you to help your city become bigger and better and to associate yourself with its leaders.

The electrical industry must be a unit in telling the electrical story to the public, just as other industries are. The manufacturers are telling the story to the entire United States; the power companies are telling it throughout their territories. The story will not be perfectly told unless the contractor-dealers tell it in their city—which is their particular territory. That you may know how to raise your advertising voice and make it blend with the whole, these articles have been written.

The Starting of a Gold Dredge

(That the West is leading in the practice of electric welding and that the average citizen of this section of the country is taking an ever-increasing interest in the industrial progress made possible by electricity is shown in this account of the starting of an electrically operated gold dredge of the latest type in Gold Canyon, Nevada.—The Editor.)

On the fifth of September the people of Nevada celebrated the beginning of a new chapter in the famous story of the Comstock district. Since the days of the Civil War this section of the West has been a leader in the production of gold and silver, but now through the application of electric power a still greater yield is being made possible.

The construction of a $350,000 steel gold dredge in Gold Canyon is the beginning of a program of development which is being planned by the Bulkeley Wells interests. A company known as the Gold Canyon Dredging Company has been formed and this is directly responsible for the dredging enterprise. The company has acquired 700 acres of ground in the valley and has reason to believe that this kind of placer mining will yield most satisfactory returns.

From every direction cars found their way to the gold dredge which stood alone in the hollow of the desert ready to start its laborious tour over the valley. Slowly but surely, working day and night, it will eventually reap the gold which lies in the surface ground of the surrounding seven hundred acres.

A side view of the steel gold dredge is shown above. At the extreme left may be seen the apparatus which supports the line of buckets which scoop the gravel and sand from the front of the pond. The leg-like spuds are seen to the right of the house portion and the stacker from which the waste is dumped is extending to the rear.

As shown in the picture above, over 2,000 prominent citizens from various parts of the state of Nevada gathered to witness the starting of this modern steel dredge and to commemorate this beginning of a new era in the gold-mining industry of the state.

This Gold Canyon dredge is not a giant in size, but it is one of the most complete and finished products ever floated. As Edwin Higgins, consulting engineer for the Wells enterprises said, "Nothing has been left off." He was especially proud to state that the dredge contains every known device for the safety of operatives. Enclosed safety switches are used throughout.

The Electrically Welded Deck

The feature of this dredge, as far as the electrical industry is concerned, is the electrically welded deck. The plates of the 108 by 46 foot deck are ¼-inch thick and were placed with a ¼-inch opening between all edges, thus providing space for welding. This made a perfectly smooth deck in noticeable contrast to the riveted deck. Two 10-kilowatt generator sets transformed the a.c. current from the line to 60-volt d.c. current which was used for welding. Two men welded the entire deck in three weeks and although the actual time spent on the job was as long and perhaps longer than riveting would have

ELECTRIC WELDING was invented by Thomson in 1889. All is not useless that was broken; if you can't afford a new one

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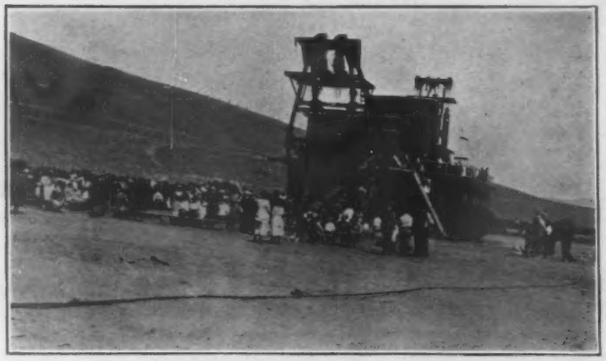
required, the time necessary in preparing rivet plates and rivets away from the job throws the balance distinctly on the side of electric welding.

George L. Hurst of the Bethlehem Shipbuilding Corp., Ltd., who designed the dredge, strongly advocated that it be entirely welded by electricity, but



Showing some of the many visitors who gathered to witness the ceremonies held in connection with the throwing of the switch which put the dredge in operation.

because this practice was new and untried others in authority did not feel safe in taking such an advance step. This one trial, however, has proved the superiority of the electric welding practice and a large California dredge, to be entirely welded by electricity, is now being planned.

Electricity and Operation —

The power used in operating this dredge is taken from Truckee River Light and Power Company lines at 4,400 volts and is carried to the dredge over a 1,500-foot cable where it is transformed to the 440-volt current used in operating the motors. The dredge has a 500-hp. load. The largest motor is 200-hp., used to operate the bucket line that scoops the gold-laden gravel from surface to bedrock and carries it up to the top of the dredge, where it is dumped into an inclined revolving grizzly and washed by a stream of water passing in the opposite direction. After the material has gone through the screen, the waste is carried up to the end of the stacker by means of a motor and is dumped behind.

As it clears a way before it this boat-like mill moves forward by means of two spuds which might be likened to two huge legs. Two 50-hp. motors control these spuds. While the boat is turned sideways one free spud is lifted and moved forward; when the next move is made the dredge is held on this forward spud while the other one is released. Thus the floating mill moves through the desert valley leaving a path of mined material behind it. In all nine motors are needed to operate the dredge.

Opening Ceremonies —

The fact that the people of Nevada considered the starting of this dredge an occasion worthy of their consideration is significant in showing how the average citizen of the West is coming to realize what electric power is doing constantly to build up the industries upon which the prosperity of their state depends. Gerald H. Hutton, general manager of the dredge, under whose supervision the boat was built in the record-breaking time of less than six months, was master of ceremonies. Mr. Higgins of the Bulkeley Wells Company was the first speaker. He gave a brief history of placer mining from the first days of the gold pan to the present days of the electrically operated steel dredge.

This speaker was followed by Dr. Walter E. Clark, president of the University of Nevada, and then by Dr. Aurelia Henry Reinhardt, president of Mills College, both of whom emphasized the necessity of higher education in preparing the men and women of the future to carry on the great industrial development possible in the West. The concluding address was delivered by Governor Emmet D. Boyle of Nevada, who touched briefly upon the difficulties that beset the men undertaking this big enterprise and of the large investment required. He empha-

A view of the line of buckets which scoop the gold-laden gravel and lift it to the top of the mill. Each bucket weighs 200 lbs. and holds nine cubic feet of gravel. They are made of manganese steel. The buckets are dumped at about the rate of 20 per minute.

sized the fact that this huge piece of complicated machinery was powerless to accomplish the things for which it was designed without the aid of electric power brought many miles over the mountains from where it was generated by the waters of the Truckee River.

After the cheering which followed the Governor's address, Mrs. Boyle threw the switch that started the machinery and the guests were permitted to view the dredge in operation.

ELECTRIFICATION OF RAILROADS IN JAPAN

The Japanese railway authorities have decided to substitute electricity for steam on all lines within the empire, according to recent reports to the Department of Commerce. The change, which it is estimated will cost 200,000,000 yen, is expected to reduce the number of locomotives in service by 40 per cent.

SPARKS—Current Facts, Figures and Fancy

(A glance at this page will assure you that there is no need to worry further about labor shortage, a dearth of fuel oil or the danger of observing the enemy camp by airplane. Significant facts concerning the interior decoration of tunnels, the value of daylight saving and another world's record for the West also appear.—The Editor.)

Why speak of labor shortage when enough hydro-electric energy is running to waste in the West to equal the daily labor of 1,220,400,000 men?

* * *

A total of 571 disabled ex-service men are taking courses in electrical engineering at the expense of the Federal Board for Vocational Education.

* * *

Western ports are encouragingly busy but even so we must still consider New York. She is still somewhat in the lead with a train arriving every 52 seconds and a ship leaving the harbor every 48 minutes.

* * *

We are pretty well wired up in this United States, considering that there are ten miles of telephone wire to every one square mile of territory. Some day wireless telephony may be a matter of necessity.

* * *

We have before mentioned the fact that San Franciscans are record-breaking talkers and now are prepared to announce that this city claims the largest telephone terminal rack in the world. This frame has about 250,000 connections.

* * *

The interior decoration of tunnels will be greatly improved and simplified by the use of a newly invented piece of machinery which sprays concrete on the interior of tunnels and almost immediately smooths it in place with swinging arms.

* * *

Brazil can see no reason for steam railroads in a country abounding in hydroelectric possibilities, so she has appropriated some eleven million dollars to cover the cost of changing a part of the railroad system surrounding Rio de Janeiro from steam to electricity.

* * *

The United States is sending 207 carloads of electrical equipment to India for the establishment of two large central stations, 90 miles inland from Bombay. The total weight of the shipment is 80,000 tons and some of the heaviest lifts between Bombay and the destination will be made by means of elephants.

* * *

Wartime flying may be a bit unsafe but why not keep the pilot safe on earth? Such is the theory of a prominent British mechanical engineer who announces that he can control his crewless aerial torpedo thousands of miles away. The torpedo can be used for photography, exploration, observation or carrying mails.

Can you suggest an easier way of saving twenty million dollars than setting your watch ahead an hour? During the seven summer months this amount was saved in our country under daylight saving. And then, as they say we are running short of coal, it is pleasing to note that 300,000 tons of this material were saved by the same process.

* * *

The four leading producers of tungsten ore are Western states, as are the leaders in the output of gold, silver, and precious stones. California, Colorado, Nevada and South Dakota lead in the production of tungsten ore, California, Colorado, Alaska and Nevada in gold, and Montana, Nevada, California and Arizona in the production of precious stones.

* * *

The United States produces two-thirds of the world's oil supply, but even at that consumes more than she can produce. There is comfort in the fact that Mexico, our next-door neighbor, has the greatest demonstrated supply in the world. If all the wells now drilled in Mexico were allowed to flow unrestrained, they would produce from 1,500,000 to 1,900,000 barrels daily.

* * *

Those of us who are attracted by the rubber pavement idea are glad to hear that it is being seriously tried out on a large scale. Half only of the road in a certain part of England is being surfaced with rubber, so as to afford a comparison in efficiency. This new material is being laid in flat slabs three-fourths of an inch in thickness, attached to steel plates, from which project broadly-flanged studs which are gripped by the concrete foundation.

* * *

After all, it seems that mountains and dashing rivers are not essential to hydroelectric development. It is reported that the French are considering the ocean as a profitable substitute. The scheme planned depends on the construction of four basins at different levels at the mouth of the River Rance. Each basin will be used for power generation at different states of the tide. They will have an aggregate area of some 50,000 acres, and it is estimated that turbines worked by the passage of water into and out of these basins will give 5,000 hp. at neap tide and ten times more at spring tide.

RADIUM was discovered by M. and Mme. Curie in 1898. All discoveries are not accidental. Look for what you want:

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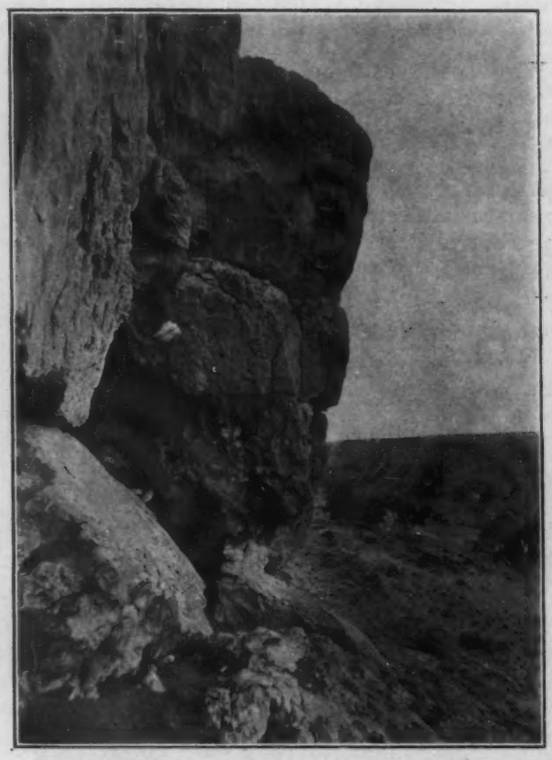
Difficulties in Hydro-Electric Exploration

Photos by W. L. Huber

Looking south from Kearsage Pass in late July, elevation 11,823 ft. The upper reaches of the Sierras are full of small glacial lakes which are important factors in any drainage area being considered for hydroelectric development. Many of these are far away from trails and frequently overlooked by any but the aviator.



Engineer descending the wall of Little Canyon, Arizona. This gives some idea of the difficulties encountered in obtaining data in country which is not even accessible on horseback. A surveying trip involving many weeks in the field is not only an expensive undertaking, but often one fraught with considerable danger.

Preparing a report to the chief engineer, 100 miles from the nearest railroad, on the Painted Desert. The Corona and the Ford as modern equipment for desert surveying parties have solved some problems of time and labor, but over regions where even the Ford cannot go the airplane and the camera pass, registering every topographical detail necessary for making development plans.

Descent from Shepherd Pass, elevation 12,000 feet, between Kern and Owens River drainages, on Owens Valley side. Days of travel with a pack train are often required to cross passes of this kind, whereas an airplane can inspect the area in a few hours, and collect valuable data on precipitation and run-off at seasons when the depth of the snow makes it absolutely impassable for horseman or foot-traveler.

Simplified by the Use of the Airplane

Photos by 15th Aerial Photographic Section, Air Service, U. S. Army. Copyright.

Panoramic view of peaks in the vicinity of Mt. Whitney

Cinder Cone and lava beds near Mt. Lassen

An upper drainage in the Kings-Kern country

Mosaic of Kerckhoff project

The photographs on this page serve to illustrate the completeness of the topographical and precitation data to be obtained through the use of the airplane, which can cover in a few hours territory which would occupy a surveying party for weeks.

Of special interest is the large mosaic showing the San Joaquin Company's Kerckhoff dam and the power house above, one of the first hydroelectric undertakings to be mapped in this way. The picture is published in connection with the article by R. C. Starr, construction engineer for the company, which appears on page 357 of this issue. Mr. Starr gives complete data on the methods employed in making aerial surveys of hydroelectric projects and the successful results achieved.

The characteristics of a drainage area vary very widely with its elevation, exposure, timber and so forth. All these factors must be accurately determined before the capacity and details of the project can be decided upon. This data can be collected with greater speed and accuracy by means of aerial photographs than by any other method.

PERSONALS

George Kidd, general manager of the British Columbia Electric Railway Company, Ltd., is chairman of the Advisory Committee of the British Columbia Cooperative Association recently launched at Vancouver, B. C., at an enthusiastic get-together meeting which brought out practically every contractor-dealer in the entire British Columbia district. Plans for a constructive program of merchandising improvement were outlined at this time which set a bogey of quadrupling present sales and the general good feeling within the industry was even more firmly cemented. The Electric Railway Company, under the progressive direction of Mr. Kidd, has taken a leading part in this movement, which has been cordially supported by all branches of the industry. Other members of the advisory committee include J. R. Read, district manager, Canadian Westinghouse Company; R. F. Hayward, general manager Western Power Company of Canada; H. Pim, district manager Canadian General Electric Company; J. F. Little, district manager Northern Electric Company; W. G. Murrin, assistant general manager, E. E. Walker, sales engineer, and James Lightbody, publicity manager of the British Columbia Electric Railway Company; W .W. Fraser, E. Brettell and S. E. Jarvis, Vancouver dealers, and F. T. Cope, a Vancouver jobber, all of whom were speakers at the recent meeting.

Robert Sibley, editor of the Journal of Electricity, has been appointed chairman of the Publicity Committee of the Pacific Coast Division, N. E. L. A.

Herbert Hoover has been appointed by Secretary Payne as consulting engineer of the advisory board of the eastern industrial region super-power survey now being made by the Geological Survey.

Vernon Kellogg, professor of entomology, Stanford University, and permanent secretary of the National Research Council, has been elected chairman of the Division of Educational Relations of that Council.

C. H. Payne, assistant chief electrician of the Western Light and Power Company at Boulder, Colorado, has resigned his position and with his father, W. E. Payne, will enter business in Florida. Mr. Payne has been in the employ of the company for ten years.

W. C. Smith, of the transformer department of the General Electric Company, with headquarters at San Francisco, will spend some weeks in the eastern centers during the coming two months, the major portion of which time will be spent at Schenectady, New York.

John C. Merriam, formerly professor of palaeontology University of California, and president-elect of the Carnegie Institution of Washington, has been elected chairman of the Division of States Relations of the National Research Council, with headquarters at Washington, D. C.

Ernest Fox Nichols, recently professor of physics at Yale University and formerly president of Dartmouth College, has accepted an invitation to assume the immediate direction of the Laboratory of Pure Science of the Nela Research Laboratories conducted by the National Lamp Works of the General Electric Company at Nela Park, Cleveland, Ohio.

D. F. McCurrach, formerly assistant engineer with the Public Service Commission of Washington, has been employed for several months past by the Pacific Power & Light Company as consulting engineer, to examine into electric operations in Washington in connection with application for increased rates.

George J. Wheat, formerly assistant superintendent of the Alameda County district of the Pacific Gas & Electric Company, is now general manager of the Wheat Electric Company, electrical contractors and dealers of Santa Maria, California, where he is engaged in the installing of irrigation pumps and a number of motors in the oil fields, in addition to the merchandising of electrical ware.

John Barrett, director-general of the Pan-American Union, has retired from that position after fourteen years of service. He is succeeded in this position by **Dr.L. F. Rowe**, who has worked with him for a great number of years. Mr. Barrett retires to private life to establish connections throughout the United States and the Pan-American countries to act as general counselor and adviser in Pan-American and other international affairs.

Irene Warren, librarian, Globe-Wernicke Company, Chicago, and well known to readers of the Journal of Electricity as author of the series of articles on Office Records—Their Filing and Indexing, has been appointed as one of a special Committee of Methods to collect, with a view to publication, from all types of special libraries throughout the country, data in regard to various methods used in these types of libraries, such as subject heading, classification, circulation and routing, literature and library publicity.

F. B. Lewis, superintendent for Southern California Edison Company, left for New York on Sept. 21 to attend the meetings of the Accident Prevention Committee of the National Electric Light Association to be held there Oct. 4 and 5. Mr. Lewis represents the Pacific Coast Section on this committee. On his return trip he will attend the meeting of the Safety Rules Committee and also the Underground System Committee, both of which will be held in Chicago. The time intervening between the two meetings will be devoted to visiting important manufacturing centers.

Carl C. Thomas, professor in mechanical engineering at Johns Hopkins University, has been elected to the Board of Managers, American Society of Mechanical Engineers. Mr. Thomas studied at Stanford University and is a graduate of Cornell University from the college of mechanical engineering, and after graduation in 1895 entered the employ of the Globe Iron Works, shipbuilders of Cleveland, Ohio. Some time later he worked for Moran Brothers, shipbuilders of Seattle, Washington, and then accepted a position as professor of marine engineering at Cornell University. Mr. Thomas was connected later with the University of Wisconsin and the University of California as instructor in thermodynamics, leaving that position to organize the newly formed department of mechanical engineering at Johns Hopkins University in 1913. During the war Mr. Thomas was connected with the American International Shipbuilding Corporation and is now located in Los Angeles as Western representative for Dwight P. Robinson and Company, Inc., Engineers, which have recently become consolidated with Westinghouse, Church, Kerr & Company, Inc., New York City. He has been very active in A. S. M. E. affairs and is the author of a book on steam turbines.

Charles H. Tallant, formerly advertising manager of the Pelton Water Wheel Company, has accepted a position with the McGraw-Hill Company as manager of the Service Department of the San Francisco office. Mr. Tallant is a graduate of Stanford University with the class of 1911 from the college of electrical engineering, and until 1916 was connected with the advertising and dealer service department of the San Francisco office of the General Electric Company. He then became advertising manager of Western Engineering, which position he held until the outbreak of the war when he joined the Grizzlies and at the conclusion of the war held the rank of second lieutenant. Mr. Tallant then became associated with the Pelton Water Wheel Company which position he held until joining the McGraw-Hill Company. The inauguration of the service department in San Francisco is only one of the ways by means of which the McGraw-Hill Company tries to render to its patrons the greatest possible service. Mr. Tallant was chosen to fill this position as he possesses those capabilities which make for increased efficiency within the organization and increased friendship for all that come in contact with the organization.

F. W. Mills, chief electrical engineer of the South African State Railway, is making a tour of the West.

R. G. Swan, hydraulic engineer of the Dominion Water Power Department of Canada, is among recent San Francisco visitors.

W. M. States, manager of the International General Electric Company at Shanghai, passed through San Francisco on his way to Schenectady.

F. G. Sykes, vice-president of the American Power & Light Company of New York, visited the various offices of the Pacific Power & Light Company recently, going to Wichita, Kansas, from here.

R. N. Buell, formerly a consulting engineer of San Francisco, now doing installation work in Melbourne, has installed the first unit of a power plant to burn pulverized lignite under boilers in Australia.

R. E. Frickey, formerly electrical engineer for the Northern California Power Company, is now consulting electro-welding engineer for the Moore Shipbuilding Company with headquarters in Oakland, California.

A. E. Morphy, secretary of the Southern California Edison Company, is making an extended trip in the East, his itinerary including the convention of the Association of Edison Illuminating Companies in New London, Conn.

W. C. Chappell, electrical engineer, the Electrical Commission, Melbourne, Australia, stopped in San Francisco the first of this week en route East. He expects to return to San Franciso and make a longer visit within a few weeks.

E. A. Palmer, engineer in the railway department of the San Francisco office of the Westinghouse Electric & Manufacturing Company, has gone East to Atlantic City, New Jersey, to attend the American Electric Railway Conference which is being held in that city.

R. F. Hayward has resigned as general manager of the Western Power Company of Canada, Ltd., Vancouver, B. C., and leaves at the end of October for Santiago, Chili, to become manager of the Santiago Light, Tramway & Power Company. Mr. Hayward came to Vancouver from England and has been connected with the company for the past eleven years.

Max Thelen, author of the California Public Utilities Act and former president of the California Railroad Commission, has resigned his position as chief of the liquidations and claims department of the United States Railroad Administration and will return to California to resume the practice of law.

Arnold J. Noerager, chief electrical engineer, Braden Copper Company, Rancagua, Chile, has been visiting in San Francisco for the past few weeks. Mr. Noerager is well known in San Francisco due to his employment in that city by the General Electric Company before going to South America.

W. R. Dunbar, supply salesman in the San Francisco office of the Westinghouse Electric & Manufacturing Company, has recently left for a trip through the East where he will visit the Westinghouse plants at South Bend, Indiana, Mansfield, Ohio, East Pittsburgh, Pennsylvania, and Brooklyn, New York.

E. O. Shreve, local manager of the General Electric Company and president of the San Francisco Electrical Development League, is spending six weeks in eastern business centers. **A. V. Thompson,** head of the railway department of the San Francisco office of the General Electric Company, accompanied Mr. Shreve East.

E. W. Dichman of the McCook Field, Dayton, Ohio, has been a visitor in San Francisco and Los Angeles for the past several weeks. Mr. Dichman is a graduate of the electrical engineering course at the University of California with the class of 1914 and contributes a very interesting article in this issue on Airplane Costs in Hydroelectric Work.

J. P. Jollyman, engineer of electrical construction, Pacific Gas & Electric Company, has been elected chairman of the San Francisco chapter of the American Institute of Electrical Engineers for the coming year. Mr. Jollyman is a graduate of Leland Stanford Junior University in the college of electrical engineering with the class of 1903. After graduation he went to work for the California Gas & Electric Corporation which later became the Pacific Gas & Electric Company remaining until 1909 when he accepted a position with the Great Western Power Company which at that time was just completing the work on the Big Bend power house. Mr. Jollyman was in charge of the power house and the changing over of the transmission line from 60,000 volts to 100,000 volts. In 1911 he returned to the Pacific Gas & Electric Company as engineer of electrical construction, which position he now holds. Mr. Jollyman had charge of the designing of the electrical and hydraulic installations at Drum Power House, Halsey Power House, Spaulding Power House, and Wise Power House which has the largest single discharge turbine in the world. He is considered one of the best electrical construction engineers in the West and is responsible for the great interconnections on the Pacific Gas & Electric Company's system.

TYPEWRITERS were invented by Sholes in 1878. If you want to exchange your fountain pen for one,

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Meeting Notices for Electrical Men

(That the electrical men of Portland are approaching the ideal of cooperation is shown in the report of a recent A. I. E. E. and N. E. L. A. meeting which appears on the following pages. The new officers of the Colorado Electric Light, Power and Railway Association, an account of engineers' activities in Utah, the launching of a cooperative association in British Columbia and an account of the annual dinner of the Seattle Section A. I. E. E. are among the notices of the important meetings which have occurred during the past two weeks.—The Editor.)

Portland A. I. E. E. and N. E. L. A. Inaugurate New Policy on Meetings

Association activities in Portland started for the year with a big get-together meeting September 28, with a good program and specialties in the way of entertainment. Over seventy were present. A. C. McMicken, sales manager Portland Railway, Light & Power Company, addressed the meeting on "The Cooperative Movement in the Northwest," and Miss Clotilde Grunsky, associate editor of the Journal of Electricity, outlined the work of the California Cooperative Campaign.

For several years past the Portland sections of the A. I. E. E. and the N. E. L. A. have been holding joint meetings, and this year it has been decided to grant the request of the Portland section of the Oregon Association of Electrical Contractors and Dealers to meet jointly each month with these combined sections. Under the old arrangement it was possible to secure better speakers than either society alone could secure, and to have refreshments and cigars each meeting, which proved a big drawing card. The new arrangement will make possible even bigger and better meetings than before. The contractors and dealers have asked to bear their proper proportion of the expense of conducting the meetings and occasionally will have a program of particular interest to them.

The officers of the three sections and the personnel of the various committees have been chosen with a view to getting real results, and it is expected that this year will be the most successful in the history of local association activities. For the A. I. E. E., E. F. Whitney is chairman and W. C. Heston secretary; N. E. L. A., A. D. Leach, chairman, W. A. Dunlap, secretary; Contractor-Dealers, F. A. Bauman, chairman, F. R. Whittlesey, secretary.

New Officers and Committees of Colorado Association

On the occasion of the seventeenth annual convention of the Colorado Electric Light, Power and Railway Association at Glenwood Springs, Colo., September 13, 14 and 15, when C. A. Semrad, Boulder, general manager of the Western Light & Power Company, was elected president, T. O. Kennedy, Denver, general superintendent Denver Gas & Electric Light Company, first vice-president, and Fred Norcross, Greeley, manager Home Gas & Electric Company, second vice-president, the new Executive Committee personnel was made as follows:

W. J. Barker, vice-president and general manager Denver Gas & Electric Company; W. F. Brown, Mountain States Telephone & Telegraph Company; Norman Reed, manager Colorado Power Company; W. C. Sterne, manager Ft. Lupton Light & Power Company; E. A. Phinney, manager Jefferson County Light, Heat & Power Company.

Advisory Committee:

J. F. Dostal, manager Colorado Springs Light, Heat & Power Company; W. F. Raber, manager Arkansas Valley Railway & Light Company; D. A. Hegerty, vice-president and general manager Western Light & Power Company; J. A. Clay, manager Western Colorado Power Company; W. P. Southard, manager Trinidad Light, Heat, Railway & Transmission Company.

The Colorado Association has always been an active state association, and it is not proposed to lose its identity with the creation of a geographical N. E. L. A. Division, mainly because the Colorado Association embraces not only electric light and power utilities but also street railway, gas and telephone utilities. It is planned to have the closest cooperation between the state association and the Geographical Division so as to avoid duplication of effort.

BUILDERS OF THE WEST — LXXXVII

R. C. STARR

"The old men for counsel, but the young men for war." It was the young men of pioneer days who laid the foundations of the empire of the West—and in the tremendous strides in the building of that empire which are the work of today, young men still are in the forefront of the battle. To R. C. Starr, chief construction engineer of the San Joaquin Light & Power Corporation, who has more than one record to his credit in expeditious work on Western hydroelectric installations, this issue of the Journal of Electricity is affectionately dedicated in appreciation of that spirit of daring—that spirit of the pioneer—which he has shown in the exploration of new fields, and the use of new methods in engineering attainment.

Oregon Contractors to Meet

The state convention of the Oregon Association of Electrical Contractors and Dealers will be held in Portland October 15 and 16.

Utah Engineers Propose Development of State Waters

The Utah Society of Engineers, Salt Lake City, at a recent meeting went on record as in favor of the vigorous prosecution of a plan for the development of arid lands, the use of flood waters and the further development of irrigation in Utah in general, as outlined by A. F. Parker, chief engineer of the Utah Water Storage Association. Mr. Parker presented a preliminary tentative draft of a bill which it is expected will be brought in some form before the next Utah legislature. The bill would create a state development service, following the suggestion rather than the general outline of the Washington state reclamation service, and as submitted proposes development of "the latent resources and possibilities inherent in water supply, hydroelectric power, irrigation and drainage" as the declared object of the proposed legislation.

The proposed board is to consist of five directors, appointed by the Governor for five years, one director retiring each year. The directors of the service are to serve without pay, except expenses incurred. The powers and duties of the board are to make investigations necessary as the "first step looking to the ultimate full development of the agricultural resources and possibilities by outlining comprehensive plans for such development"; to adopt policies for the development of the agricultural resources, and assist in the formation of

districts; to market bonds of irrigation districts taken in payment for construction of works which may come under the jurisdiction of the board; to construct, operate or lease power plants primarily for the pumping of irrigation water; to make necessary water filings, the board being allowed first consideration and right from the state engineer; to cooperate with the United States Government in reclamation and settlement work, and to cooperate with adjoining states in development of interstate water supply.

Cooperative Association in B. C. Launched in Vancouver

The British Columbia Electrical Cooperative Association was launched on Sept. 21 at a big rally and dinner held in Vancouver, B. C. It was by far the largest gathering of electrical men ever held in Vancouver, numbering some one hundred and fifty representatives of central stations, manufacturers, jobbers and contractor-dealers. From the marked enthusiasm of the gathering the success of the movement was considered assured.

George Kidd, general manager of the British Columbia Electric Railway, was chairman. Plans of the organization were laid before the gathering showing the division of the work of the advisory council into its various branches. These departments will be handled as follows: merchandising, E. E. Walker; accounting, J. Martin; advertising, James Lightbody; store and window display, E. Brettell; architects, S. E. Jarvis and W. W. Fraser; contractors, F. T. Cope and W. C. Mainwaring.

Among the speakers were: J. R. Read, district manager, Canadian Westinghouse Company; W. G. Murrin, assistant general manager, British Columbia Electric Railway Company; R. F. Hayward, general manager, Western Power Company of Canada; H. Pim, district manager, Canadian General Electric Company; J. F. Little, district manager, Northern Electric Company; E. E. Walker, sales engineer, and James Lightbody, publicity manager, British Columbia Electric Railway Company; W. W. Fraser, E. Brettell, and S. E. Jarvis, Vancouver dealers, and F. T. Cope, a Vancouver jobber.

Figures produced set the sales bogey for greater Vancouver at $1,570,600. This figure was made up of domestic appliances, fixtures and shades, lamps and wiring sundries, and it was estimated that of the domestic appliances only about half were being sold annually which should be sold in that time. A resolution endorsing the Association and pledging one hundred percent support was passed.

Joint Technical Societies of Los Angeles

H. A. Barre, executive engineer for the Southern California Edison Company, addressed the Joint Technical Societies of Los Angeles at a recent luncheon, taking for his subject future power possibilities in California. The speaker dwelt particularly on the program of the Edison Company which calls for the bringing in of 750,000 horsepower of hydroelectric energy during the next fifteen years. It is proposed to develop 50,000 horsepower annually during this period at a total cost of $200,000,000. Geo. Damon officiated as chairman of the day.

San Franciscans Hear Talk on Accident Prevention

An interesting phase of the "Workings of the Workman's Compensation Law" was brought out on October 4 by Judge A. E. Graupner at the weekly meeting of the San Francisco Electrical Development League. The speaker dwelt at length on the economic necessity of preventing accidents resulting from contact with electric circuits and electrical machinery and of assisting partially incapacitated workers in getting back into their vocations and becoming self-respecting citizens again rather than objects of charity.

Judge Graupner stated that he believed 30 per cent of the industrial accidents were preventable, either by the owner, the superintendent or the employe. Last year there were over 108,000 compensative accidents in California, of which 568 were fatalities.

The scheme of rehabilitation and vocational training of the wounded was devised first by Belgium, then France, Canada and the United States. This is now being worked out in various states of the Union for industrial cases, and there is an act in force in California for industrial rehabilitation—to put the incapacitated worker back on the job.

Rocky Mountain N. E. L. A. Elects Officers

Officers elected at the first annual convention of the Rocky Mountain Division N. E. L. A., held September 13, 14 and 15 at Glenwood Springs, Colo., are as follows:

E. A. Phinney, president, Golden, Colo., Jefferson County Power & Light Company; E. P. Bacon, first vice-president, Casper, Wyo., Natrona Power Company; Arthur Praeger, second vice-president, Albuquerque, N. M., Albuquerque Gas & Electric Company; D. C. McClure, third vice-president, Denver, Colo., Denver Gas & Electric Light Company; A. C. Cornell, secretary, Denver, Colo., Western Electric Company.

Executive Committee consists of officers and:

C. M. Einhard, Roswell, N. M., Roswell Gas & Electric Company; J. A. Clay, Durango, Colo., Western Colorado Power Company; F. H. Roberts, Riverton, Wyo., Popo Agie Light & Power Company.

Section chairmen: Public Relations, Bulkeley Wells, Denver; Commercial, C. N. Stannard, Denver; Technical, T. O. Kennedy, Denver; Accounting, C. E. Twogood, Albuquerque, N. M.

Committee chairmen: Membership, C. R. Rudy, Denver; Accident Prevention, J. F. Dostal, Colorado Springs; Company Employes Organization, D. A. Hegarty, Boulder; Wiring, W. P. Southard, Trinidad.

The program of the convention was discussed in these pages on October 1.

Seattle Section A. I. E. E. Meets For Annual Dinner

The Annual Dinner and Get-Together Meeting of the Seattle Section of the A. I. E. E. was held on September 21 at the Hotel Butler in Seattle, a total of fifty members, students and visitors being present. After the dinner G. E. Quinan, chairman, spoke on the honor conferred on the Section by the election of a vice-president and introduced Dr. C. Edward Magnusson who was recently elected to that office. Dr. Magnusson stated that he intended to follow Mr. Fisken's Institute policy with which he had always agreed. He also referred to the loyalty of the members to the Seattle Section, emphasizing the fact that in most cases their own men furnished the papers presented, in contrast to the practice of some of the Eastern Sections. He thought the Section should study methods of making this district a factory and manufacturing industries center.

Mr. Quinan referred to the annual convention of the Institute which was held at White Sulphur Springs, West Virginia, last June and introduced the delegate, Willis T. Batcheller, secretary-treasurer of the Seattle Section, who made a full report of the meeting of Section delegates.

Territorial limits were referred to as of vital importance to Western Sections where the sixty-mile limit is insufficient. The Seattle Section has 150 men who are active and 15 or 20 applications under consideration. The chairman mentioned the present tendency to sectionalize the country, forming geographical divisions each with a district vice-president. He explained the tentative divisions arranged for. West of the Mississippi there were only 2,000 members out of a total of 12,000.

Electrical Supply Jobbers' Association

The Electrical Supply Jobbers' Association of the Pacific Coast will meet at Del Monte on October 21, 22, 23. Those planning to attend should communicate with Albert H. Elliot, secretary, well in advance.

MOTION PICTURE MACHINES were invented by Edison in 1889. If the family won't keep still while you use a kodak,

THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

HAPPENINGS IN THE INDUSTRY

AIRPLANE USED IN LOCATING A RAILROAD

Locating a railroad by airplane has been carried out by the Third Aero Squadron, Camp Stotsenburg, Philippine Islands, according to a recent news letter of the Air Service of the United States Army. In one long flight a railroad engineer was enabled to determine the proper one of three general routes to be used for the new road. Instead of three parties of locating engineers being sent out to make the survey, it will be necessary now for only one party to go out. It is expected that many months and thousands of dollars will be saved in the work. The new line is a project of the Manila Railroad Company and an extension of its line from Cabanatuan through parts of the provinces of Nueva Ecija and Nueva Vizcaya to Bayombong.

MOUNT SHASTA POWER AUTHORIZED TO PROCEED ON PIT RIVER

Authority to proceed with the Pit River project was granted by the California Railroad Commission on Oct. 7 to the Mount Shasta Power Corporation. As part of an ultimate scheme of development of the Pacific Gas & Electric Company of approximately $125,000,000, this project involves the construction of five or more hydroelectric plants on the Pit River, utilizing the water of the Pit between the confluence of the Fall River and the lower end of Big Bend, between which points a development of over 300,000 kw. is anticipated.

NEW OFFICERS FOR SHELLEY POWER IN IDAHO

John F. Shelley, owner of the Shelley Light & Power Company, Shelley, Idaho, has sold eighty-five per cent of his holdings in the company, and at a recent meeting new officers and a board of directors were elected, as follows: H. L. Malcolm, president; F. C. Mickelson, vice-president; F. M. Davis, secretary; W. S. Wright, treasurer; John Jorgensen, manager; T. J. Bennett, Nelson Miller and Edward Wadsworth are additional directors. The new owners intend to make several important improvements. Another unit will be added to the plant, and an electric supply shop will be opened.

THE CAPITOL FROM THE AIR

The Army Air Service is now cooperating with map-making companies in making detailed maps of the immediate vicinity of Washington. The above view of the capitol was taken by the 15th Aerial Photographic Section, Air Service, U. S. Army. It must not be reproduced without permission.

RATE INCREASES IN OREGON MUST BE AUTHORIZED BY COMMISSION

Public utilities in Oregon cannot advance their rates or charges without a public hearing before the Public Service Commission and an order from that body authorizing the increase, according to an opinion prepared by Attorney-General Brown. "It is apparent that if the rates prescribed by the commission may be abrogated by the utility filing a new schedule, the force and effect of the commission's order amounts to little," the opinion holds. It is Mr. Brown's opinion that, as far as rates which have been fixed are concerned, the only way to change the same is by a suit in court or by a complaint with the commission on the ground that they are unreasonable, or by original complaint filed with the commission.

COMMITTEE FORMED IN CALIFORNIA ON ELECTRICAL SAFETY MATTERS

The Joint Committee on Electrical Safety Matters, recently formed in California, with main committee headquarters in San Francisco, has outlined its plan of organization and elected W. M. Shepard as chairman and R. A. Balzari as secretary. This plan is to be submitted to each of the organizations comprising the committee, that is, the Pacific Coast Division N. E. L. A., California Electrical Contractors and Dealers' Association, A. I. E. E., Manufacturers' Safety Association, Pacific Coast Division Electrical Supply Jobbers, San Francisco Electrical Development League, and California Association of Electrical Inspectors. The Los Angeles Sub-Committee will consist of a member from each of the foregoing except the Development League.

It is the committee's object to consider such safety or safety legislation matters as are of general interest to the entire electrical industry. Its motive is to represent the electrical industry on safety matters and to assist the Industrial Accident Commission in applying their safety orders.

SOUTHERN CALIFORNIA EDISON COMPANY APPLIES FOR CONSTRUCTION CERTIFICATE

The Southern California Edison Company on Oct. 4 applied to the Railroad Commission of the state of California for a certificate of convenience and necessity under which to undertake the construction of reservoirs, conduits, tunnels and power plants declared to be necessary if the company is to meet demands upon it for electric energy, these demands being in excess of present generating capacity. The plans propose a reservoir at Florence Lake with a capacity of 43,224 acre-feet, formed by the construction of a concrete arch and gravity dam 126 ft. high and 2,970 ft. long, costing about $2,226,000. From this reservoir to Huntington Lake there is proposed a tunnel 68,000 ft. long, 15 ft. in diameter, with a carrying capacity of 1000 c.f.s., costing about $11,800,000.

A reservoir at Shaver Lake of 138,570 acre-feet will be formed by a reinforced concrete mutiple arch dam 2300 ft. long and 183 ft. high across Stevenson Creek, the cost to be about $4,310,000.

Big Creek Power House No. 2-A, an extension of the present Big Creek Power House No. 2 and of similar construction to it, is provided in the plan. This will operate under a mean static head of 2,418 ft., the capacity of the station being 300,000 hp. and the cost estimated at $9,950,000, including necessary equipment.

From Shaver Lake dam a tunnel 17½ ft. in diameter and of 1500 c.f.s. carrying capacity, 13,900 ft. long, is to be built toward Big Creek Power House 2-A. The lower end of the tunnel will join two penstocks weighing 30,000,000 lb., extending to the water wheels of the power house. Estimated cost of the tunnel is $2,140,000 and of the penstocks, $4,780,000.

Across Big Creek, below Power House 2-A, will be built a cyclopean arch concrete diversion dam 210 ft. long, 58 ft. high, at an estimated cost of $104,000. From the forebay of this dam is to be a tunnel 20 ft. in diameter of 2,575 c.f.s. carrying capacity and 5,633 ft. in length through solid granite toward the new Big Creek Power House No. 8. The lower end of the tunnel will connect with four parallel penstocks to four water wheels in this power house. Each wheel is of the reaction type, connected through a vertical shaft to its alternator, the combined capacity being 120,000 hp. An outdoor bus and transformer station is to be constructed near No. 8 to transform the station output to three-wire, three-phase, 150,000 volts. Estimated costs are given as, tunnel, $1,300,000; four penstocks, of 6,250,000 lb. weight, $1,000,000; Big Creek No. 8 power house, including equipment, transformers, etc., for 90,000-kw. capacity, $2,700,000; miscellaneous structures, $100,000; one and six-tenths miles of 150,000-volt transmission line, $16,000.

N. E. L. A. STARTS MONSTER PUBLICITY CAMPAIGN

In a letter to the members of the National Electric Light Association, George F. Oxley, director of publicity of that association, sets forth the plan of the good-will campaign which the N. E. L. A. has launched on a very large scale. Already a million copies of the literature have been ordered, but that number is far short of the amount that will eventually be ordered if the association's message is to reach every user of electric light and power in the country.

Mr. Oxley outlines the situation existing today in the industry, touching on the lack of power under unprecedented demand, the constantly increasing volume of finances which must be poured into the industry to permit its development, the difficulty in getting money and the high rates which must be paid for it, the necessity for taking the consumers absolutely into the confidence of the utilities and making them realize the co-partnership existing between consumer and central station.

Quoting from the letter:

"It is with a full realization of these fundamental facts that the N. E. L. A. has inaugurated a good-will campaign, which it is hoped and expected will be the largest campaign of its kind ever undertaken by the industry. Through the medium of its 'Kilo Watt' campaign, more than one million homes will be reached every month with a message, first, regarding the uses of electricity and on terminology of the electrical industry, and later regarding the problems of finance and operation. Through the public press and other popular magazines articles directed towards the same end already are appearing and will continue to appear during the year's campaign. Manufacturers of electrical machinery, equipment and appliances will devote a large part of their advertising space to national advertising mediums and in the smaller magazines and local newspapers to cooperation in this campaign. The Investment Bankers' Association of America is cooperating in the campaign and has prepared a series of pamphlets which will go out to at least 500,000 electrical industry security holders each month."

Three pieces of literature being used in this campaign are the "Kilo Watt," which is a story of Mr. Kilo Watt, "Everyday Electrical Terms and Usage" and "Facts Every User of Electricity Should Know."

PRICE LIST and ORDER FORM
Chapter 1 I am Kilo Watt
Everyday Electrical Terms and Usage
Facts every user of Electricity Should Know No1

Nothing is more successful in telling the story of electricity than these attractive pamphlets which are being distributed by the Publicity Department of the N. E. L. A.

EMPLOYES PURCHASE 40% OF PUGET SOUND POWER NOTE ISSUE

Establishing what is said to be a new record for bond sales in the Northwest, the Puget Sound Power & Light Company, Seattle, recently disposed of $1,000,000 worth of five

Form M17-A 9M6 1-7-20

PUGET SOUND TRACTION, LIGHT & POWER CO.
SEATTLE DIVISION

MEMORANDUM

To Mr. U.R.THRIFTY Seattle, September 18, 1920.

From Mr. I.C.INTEREST

Subject GROWING all over the district in our 5-year, 8% Gold Coupon Notes.

Dear Buddy:

As our quota for the Seattle Division is only $550,000 my thought is that—

FIRST: Every employee THAT CAN should get in before it is too late, as aside from being an unparalleled investment, it would be a wonderful testimonial to our personnel. 81% employees in or better would top the record.

SECOND: It still would be more wonderful if each of the approx. 700 employees of the Seattle Division could have set opposite their names the record of at least one sale to a non-employee. Even at the lowest denomination this amounts to $70,000. From this you can see the possibilities. Each surely has from one to ten friends who would greatly appreciate this investment opportunity being brought to their attention. Orders coming in so fast we may have to close sale before Saturday, Sept.25.

Sincerely yours,
R.W.Clark.

The effective letter which helped make bond holders of over 1000 of the Puget Sound Company employes.

year, eight per cent, gold coupon notes in eleven working days, although twenty days' time was assigned to complete this task. The notes were in denominations of $100, $500 and $1,000. An executive of the company, commenting on the results, said:

"An interesting example of the modern tendency toward cooperative ownership of large corporations is shown in the subscription list for the $1,000,000 note issue of the Puget Sound Power & Light Company just closed. Through the efforts of the organization itself and without any underwriting by bond houses, the issue was distributed all over the territory served, from the Canadian boundary to Olympia, in small sizes and in many hundreds of subscriptions.

"Over 1,000 employes of the company (more than one-half of the total number of persons employed) became interested in the company's securities in this short space of time and the purchases by employes alone absorbed more than 40 per cent of the total issue. The participation by the public served and the employes in the ownership of the property is bound to result in a benefit to all concerned through keeping the income from the securities in the Puget Sound district and in broadening the interest and understanding of the company's operations and problems in the 147 communities served."

TALKING MACHINES were invented by Edison in 1878. If yours keeps the baby awake and must be sold,

THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

GREAT WESTERN'S 1919 FINANCES SHOWN IN ANNUAL REPORT

Touching on the progress and scope of the activities of the Great Western Power Company of California for the fiscal year ending December 31, 1919, shown in the letter from the president to the stockholders, there appears a consolidated statement of income and profit and loss, with intercompany items eliminated, as follows:

Operating revenues	$5,172,877.86
Operating expenses	2,065,893.25
Net earnings	3,106,984.61
Other income credits	240,116.18
Gross income	3,347,100.79
Income charges	652,921.94
Net income before charging interest on funded debt	2,694,178.85
Interest on funded debt	1,667,839.91
Net income for the year	$1,026,338.94

RECLAMATION BILL TO BE PRESENTED AT NEXT CONGRESS

The reclamation bill calling for a $500,000,000 appropriation to be presented to the next session of Congress will be framed by the Northwest Reclamation League, formed recently at Seattle. In presenting this bill, the league will work in conjunction with the Western States Reclamation Association, the parent body, and other Western reclamation bodies, it was announced by James Ford, secretary. The proposal is to lump the reclamation appropriation under one general bill and then to have the disbursements made equitably among the various Western reclamation projects.

GROWTH OF CENTRAL STATIONS IN THE WEST IN 1920

During the present year, the central stations in the Western states are adding capacity and transmission lines to the extent of nearly $35,000,000, according to results taken from a recent survey of the central-station industry of the United States, made by the Electrical World, and shown in the accompanying table. An addition of 61,458 kw. is to be added to steam plants this year at a value of $5,861,855, while to hydroelectric plants the additions will amount to 186,500 kw., valued at $28,709,591. Total additions are 247,958 kw., representing $34,571,446. Because some companies do not contemplate plant additions but will make transmission additions, and some report both generating and transmission additions, it is not a true indication of the cost per kilowatt installed to divide the total value of all additions by the increased plant installation.

From the report, about 1,500,000 kw. will be added to generating capacity in all the states of the Union, and the value of these additions will approximate $150,000,000. These figures are interesting in view of the unusually high cost of money, labor and materials.

CALIFORNIA CONTRACTORS ACTIVE FOR MORE OUTLETS

As a result of the electrical homes which have been conducted by the California Electrical Cooperative Campaign, the necessity for ample provision being made in new construction for convenience outlets has been brought home forcibly to the California State Association of Electrical Contractors and Dealers which is itself a part of the Cooperative Campaign.

To the end that some uniform action may be devised which will bring forth this result, a committee from the California State Association of Electrical Contractors and Dealers has been formed and has requested meetings with similar committees appointed from the A. S. M. E., the A. I. E. E., and the I. E. S. for joint consideration of this matter. It is interesting to note the desire of the California State Association of Electrical Contractors and Dealers to get away from individual effort and through cooperative means put this forward movement on a broad basis.

SESPE POWER CORP. PLANS FIVE WATER-POWER UNITS ON SESPE RIVER, CALIFORNIA

Sespe Power Corporation, which plans the construction of five hydroelectric power units on the Sespe River, Ventura county, California, on Sept. 28 was authorized by the Railroad Commission to issue $2,000,000 of bonds and $1,000,000 of its common stock to secure funds with which to carry out its development program. The company asked for a $3,000,000 bond issue. None of the money raised by the stock and bond issue is to be expended, however, until there are sufficient funds on hand to construct the plants expeditiously. In the event that the company is unable to finance the project, the money is to be returned to the stockholders, says the Commission, less such an amount as may be allowed by the Commission for expenses. Among the restrictions governing the financing of the proposed new utility is one requiring that for every $1,000 bond sold the company must sell concurrently at least $1,000 of stock at par. Of the authorized stock issue $100,000 is to go to the Sespe Light and Power Company for the properties the Sespe Power Corporation proposed to develop.

The Sespe company's estimate of construction costs totaled $3,722,748. The Commission's engineers say this figure is entirely too low. Their estimate is $5,500,000. The corporation's estimate of output, 197,962,017 kilowatt-hours, is not concurred in by the Commission's engineers, who hold that only an average annual output of 75,000,000 kilowatt-hours can be depended upon.

Authorization is given the company to enter into an agreement with the Southern California Edison Company to sell to the Southern company the output of the hydroelectric plants.

Additions to Mountain and Pacific State Central Station Capacity and Transmission Lines During 1920.

	STEAM PLANTS			HYDRO-ELECTRIC PLANTS				
	Capacity Jan. 1, 1920 K.W.	Additions 1920 K.W.	Value of Additions	Capacity Jan. 1, 1920 K.W.	Additions 1920 K.W.	Value of Additions	Total Additions K.W.	Total Value of Additions
City of Tacoma Light Department	.....	.....	.....	24,000	.....	$ 30,000	.....	$ 30,000
Colorado Power Co.	4,775	1,475	$ 135,000	26,900	.....	.....	1,475	135,000
Eastern Oregon Light & Power Co.	450	1,500	175,000	2,550	.....	30,000	1,500	205,000
Great Western Power Co.	26,000	.....	.....	65,000	44,000	8,500,000	44,000	8,500,000
Los Angeles Bureau of Power and Light	.....	.....	.....	30,500	30,000	2,750,000	30,000	2,750,000
Los Angeles Gas & Electric Corporation	22,908	13,333	681,480	.....	.....	.....	13,333	681,480
Pacific Gas & Electric Co., Phoenix, Ariz.	750	.....	250,000	.....	.....	.....	.....	250,000
*Pacific Gas & Electric Co.	117,000	12,500	950,000	194,875	1,000	2,096,200	13,500	3,046,200
Pacific Power & Light Co.	6,240	3,750	1,300,000	15,775	.....	.....	3,750	1,300,000
San Joaquin Light & Power Corporation	16,750	11,900	930,375	32,000	40,000	2,698,391	51,900	3,628,766
Seattle Municipal Light & Power Co.	22,500	15,500	1,250,000	14,875	15,000	1,075,000	30,500	2,325,000
Southern California Edison Co.	107,482	.....	.....	119,190	46,500	10,000,000	46,500	10,000,000
Utah Power & Light Co.	16,000	.....	.....	113,475	10,000	1,530,000	10,000	1,530,000
Wenatchee Valley Gas & Electric Co.	.....	1,500	190,000	2,750	.....	.....	1,500	190,000
Western States Gas & Electric Co.	2,250	.....	.....	6,075	.....	.....	.....	.....
TOTAL WESTERN STATES	343,105	61,458	$5,861,855	647,965	186,500	$28,709,591	247,958	$34,571,446

*Includes Pacific Gas & Electric Co., Northern California Power Co., Sierra & San Francisco Power Co.

RATE INCREASE ASKED BY LOS ANGELES GAS & ELECTRIC

Los Angeles Gas & Electric Company has applied to the California Railroad Commission for authority to increase its electric rates, saying that the present rates are those in effect before the war.

SAN JOAQUIN STARTS WORK ON A NEW 60-MILE LINE

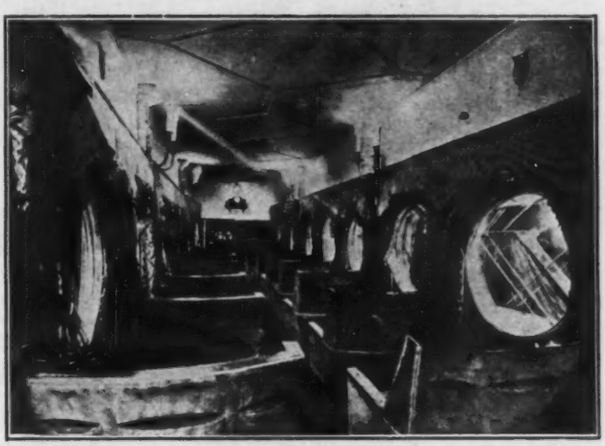
Work has been started on a high-tension power line 60 miles long connecting the San Joaquin Light & Power Corporation's new Kerckhoff power house with Merced, where a new transformer station is now under construction. The power will be stepped down for distribution in the Merced district to serve a large number of farm pumping plants on the waiting list. The line will also connect with the Pacific Light & Power Company's main line at Newman for interchange of power between the Sacramento and San Joaquin valleys. The new line, having a capacity of 30,000 kilowatts at 110,000 volts, will pass through 25 miles of mountains in a 50-mile course due west from the Kerckhoff power house, to a point south of Merced, when it will change course northerly for a distance of 15 miles.

BETTER OUTLOOK IN HOME BUILDING INDUSTRY

Two matters of interest have recently come to the fore which would appear to be important factors in new residence construction. In the first place the American Wholesale Lumber Dealers' Association, according to an announcement by L. R. Putnam, managing director, has made an average cut in lumber prices of 28 per cent from the February price list. At the same time it is not unreasonable to expect this cut in lumber prices to affect other building-material lines.

In the second place, representative M. C. Kelly of Pennsylvania is reported to be framing a bill which he will introduce at the December session of Congress which will provide for the loaning of money by the Postal Savings Banks to persons wishing to build homes. The bill is aimed to relieve the housing situation and its sponsor declares that there are 55,000,000 persons in the United States living in rented houses, many of whom would build if they were provided with the necessary cash at a reasonable rate of interest. He urges removal of the $2500 deposit limit, an increase in the rate of interest, and seeks provisions for loaning money to persons within the postal districts.

FLYING DE LUXE



The passenger compartment of a Handley-Page passenger airplane which has been making regular flights between London and Paris since May 1. In six months of flying, and with a mileage of 303,000 miles there were only two fatalities on this line, both to pilots.

RATE INCREASES GRANTED TO PACIFIC POWER & LIGHT

The Public Service Commission of Washington on September 29 handed down a decision in the case of the Pacific Power & Light Company concerning applications for rate increases made in March on all cities and towns served by the company in Washington, involving gross annual increases of $240,000.

All the company's requests were granted with the exception of Yakima, Walla Walla, Pomeroy and Toppenish. The proposed increase at the first two were reduced by 1 cent net on each step, and on the other two by ½ cent net on each step. All rates go into effect as of meter readings taken on Sept. 15 and later. No change was asked for in cooking or irrigation power. The increases cover domestic and commercial metered lighting, flat commercial lighting and commercial and flour milling power.

WASHINGTON WATER POWER TO EXTEND LINE

An extension of the power line of the Washington Water Power Company, Spokane, Wash., from Colfax to Albion, a distance of ten miles, at an estimated cost of $25,000, was announced by W. E. Coman, general manager of the company, early this month. Work on the line will begin immediately. There will be at least 30 extensions to farmers along the way, virtually every farmer between Colfax and Albion having signed up to take advantage of the electric power. Already the people of Albion and the farmers are beginning to buy washing machines, vacuum cleaners and other electric appliances, it is reported.

TRADE NOTES

Offices Established in Oregon —

The Coast Equipment Company, of which L. A. Somers is the Pacific Coast representative, has arranged for Messrs. Conway & McCalley to handle its business in Oregon. Offices will be maintained in the Lewis Building, Portland.

The Coast Equipment Company is now operating offices in Los Angeles, San Francisco, Portland and Seattle.

Contract Awarded —

The McMyler Interstate Company of Cleveland, Ohio, with offices in the Merchants Exchange Building, San Francisco, and the Hoge Building, Seattle, were recently awarded a contract by the Port of Astoria, Oregon, for four electrically operated cargo cranes.

Distribution Manager in the West —

P. A. Boeck, manager of distribution of the Celite Products Company, New York City, is now located at the company's Los Angeles office where he will supervise the production work. **Thos. G. Lee, Jr.,** will act as general sales manager with headquarters in New York.

Consulting Engineers Consolidate —

J. C. Stevenson and **R. L. Koon** announce their consolidation, Oct. 1, under the firm name, Stevens and Moon, Consulting Engineers, Portland, Oregon. They plan to give particular attention to matters pertaining to municipal improvements, water supply, sewerage, irrigation, hydroelectric power, appraisals and valuation.

CASH REGISTERS were invented by Patterson in 1885. Don't use yours as a paper weight if you've anything to sell.

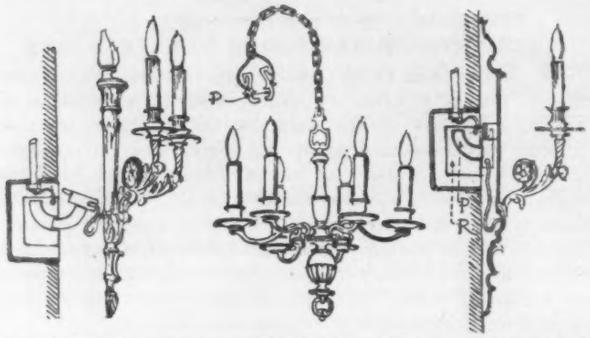
THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

LATEST IN EVERYTHING ELECTRICAL

(A very probable solution to the problem of fixtures out of harmony with the furnishings of a room is presented on these pages along with descriptions of a new type bushing for the outdoor transformer; the latest helps for exposed wiring, and a new appliance which will be of especial value both in the industrial and domestic world. Reviews of the 1920 edition of the McGraw Central Station Directory and of a remarkable booklet on California hydroelectric securities are among the Books and Bulletins.—The Editor.)

MAKING FURNITURE OF FIXTURES

It is not unlikely that the electric lighting industry is on the crest of a wave of expansion that will make the present proportions of the industry seem insignificant within a few years. If this prediction is fulfilled, the credit will again be due to the constant stream of new ideas.



The placing of a well bracket fitted with a White supporting plug is shown on the left. In the center is a chandelier with its hook-like contacts, while to the right may be seen a bracket in place on a White supporting outlet.

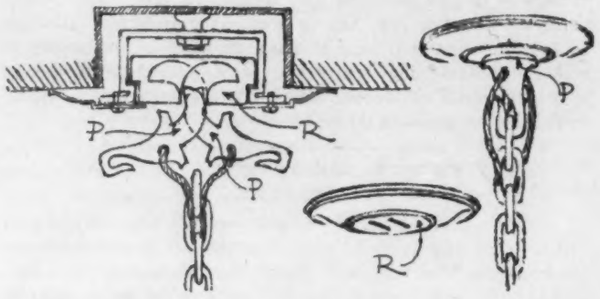
Up to a few months ago, soldering and tapering was the only method used to install chandeliers and wall brackets. From an illumination point of view this method, despite the fact that it has been the standard accepted practice, is woefully inadequate. A fundamental law of correct illumination is to supply light where it is needed. The method that has been in practice reversed this procedure—the need must be brought to the light. It was like bringing the mountain to Mohammed. The chandelier was made fast to the ceiling; or the wall bracket fastened to the wall, and the furniture in the room arbitrarily arranged to fit the needs of illumination.

Shortly after the beginning of this year, a rumor was current among electrical men that a new invention had been evolved which would revolutionize the present system of electrical "fixture" installation. Confirmation of this report was soon found in the formation in New York City of an organization to promote such a development. The inventor is E. Cantelo White, who is manager of the general lighting department of the Western Electric Company. Mr. White has to his credit the invention of the Duplex system of lighting, as well as the standard plug connection.

The new connection for chandeliers consists of a ceiling receptacle into which two curved prongs fit snugly. The ceiling receptacle slots are curved like two arcs backed one against the other, the plug consisting of a pair of independent curved contacts held securely in place by a link of the supporting chain. The curved contacts lock into place and provide the support of the lighting fixture.

Similar though it is in principle to the baseboard connection, it can be readily appreciated that here the similarity ends, for in the baseboard connection the receptacle slots would be vertical and provide no support for the chandelier, while in Mr. White's invention they are curved, to give the necessary support. Outwardly the receptacle is a neat, scarcely visible little plate, which is flush with the ceiling.

To hang the chandelier it is merely necessary to slide the plug prongs into the receptacle slots and lock them in position by clipping the supporting link over the protruding hooks of the contacts. The wall bracket connection is not very different. The curved plug prongs, or contacts, instead of curving in opposite directions, parallel one another; while the



To the left is shown the method of inserting the curved contacts for ceiling fixtures. The ceiling outlet, or curved receptacle with curved contact slots, is shown in the center, while the complete connection appears to the right.

receptacle is provided with two similarly curved arc-shaped slots. A down-and-up adjustment of the bracket permits the prongs to enter and snap into place, the base of the plug resting firmly against the face of the receptacle plate. Fixtures may be removed as easily as they are installed—by an upward movement.

TRANSFORMER HOUSES MAY BE ELIMINATED

A new type of bushing for outdoor type transformers of moderate valtage has been developed by the General Electric Company. This bushing has received the approval of the inspection department of the Associated Factory of Mutual Fire Insurance Companies. The scheme provides that all circuits, generally above 600 volts, be brought to the housing in enclosed cables. This cable is above ground, in a metal duct which is securely fastened to the transforming cover, all exposed parts being at ground potential, and water-proof. The water-proof feature is essential, from the Underwriter's standpoint, in making it safe for firemen to play streams on burning buildings near the transformers.

The new type of bushing

The lower portion of the bushings is similar to the standard General Electric high voltage bushing, while the upper portion is shown by the illustration. Ample clearance is provided in the housing. The transformers receive standard high potential test with housing position and without any taping or other insulation on the bushings. The use of these transformers is only limited, as regards voltage, by the voltage limits of the underground cable.

NEW CONDUIT BODIES FOR EXPOSED WIRING

Four representative outlet-box manufacturers have recently brought out a line of pressed steel conduit boxes with knockouts—a line so highly standardized that virtually the whole range of exposed conduit wiring requirements for ½-in. and ¾-in. conduits is compassed with but three basic bodies and two connectors, which, when combined in any form desired, result in a conduit body.

To meet the requirements of exposed wiring a conduit body must be rigidly connected to the conduit without support. The connector affords just such a rigid arrangement, according to the statement of the manufacturers. The two connectors employing the Chase nipple features, one designed for ½-in. conduit and the other for ¾-in. conduit, both fit the one size of knockout used in all the three bodies.

These conduit bodies are adaptable to virtually any standard make of wiring device. With three bodies, two connectors and fifty-five covers, there are few standard exposed wiring device jobs that cannot be handled.

It is expected that these conduit bodies will effect economy through low stock investment for a complete line, with a corresponding reduction in shelf space; through saving in time of wiremen who can almost instantly adapt a conduit body to virtually any standard condition, and through their ready reception of any standard make of wiring device, thus eliminating the necessity of duplicating stock investments.

The new line is being exploited independently by the Sprague Electric Works, which has adopted the trade name of "Spraguelets"; Thomas & Betts, who are calling their line "T & B Conduit Bodies"; the Pratt-Chuck Company, which names its product "Pratt Conduit Bodies," and the Steel City Electric Company, which has adopted the trade name "Wirelets."

A COMBINATION FAN AND HEATER

Circulating heat is often of inestimable value both in the industrial and domestic world. For this reason a combined fan and heater has recently been developed and placed on the market by the Thermo-Fan Electric Co., Inc., 2 Columbia Circle, New York City. A special nichrome heater coil is attached to the guard of a standard electric fan and the operation of the Triplex blows air through the coil, heating it and circulating it through the room. The Triplex attaches to any socket, plugged in with a current tap, giving independent connection to fan and heater. The fan and heater operating together consume 660 watts in the domestic size. In larger sizes it is being made for drying photographic work, printing, oils, tobacco, spaghetti, and in many other processes where a controlled circulating heat is needed.

The Triplex combination fan and heater which is valuable for either drying hair in the home or spaghetti in the factory.

MERCHANDISING HELPS FOR THE ROYAL DEALER

The various methods of advertising the Royal vacuum cleaner, manufactured by the P. A. Greier Company of Cleveland, Ohio, have been presented to the electrical dealer in a beautiful 12 x 18-in. booklet. Samples of national magazine and newspaper advertising are shown, notice being given that the cuts shown will be furnished any dealer on request. Samples of various types of window posters are also given.

Books and Bulletins

McGraw Central Station Directory and Data Book 1920 Edition

Compiled by the McGraw-Hill Company, Inc., and published by the McGraw-Hill Book Company, Inc., 239 West 39th St., New York; 870 pp., 4 x 8½ in. On sale at the San Francisco office of the McGraw-Hill Publishing Company, Rialto Building, San Francisco.

All the resources of the McGraw-Hill organization, its field force, its editors and its correspondents, have contributed to make the 1920 edition of the McGraw Central Station Directory and Data Book a complete survey of the electric lighting and power field.

Under each state section, all cities and towns possessing a power plant or substation of any size are listed alphabetically. Under each city or town division the population is given first, then every power organization, municipal or private, is listed. Under the name of each of these organizations the main office address, history, system, valuation and officers are given. It can be seen that this directory of 6,133 electric lighting, power and transmission systems serves not only as an inventory of the power plant and substation equipment of the lighting and power field, but also as a Who's Who of the electrical industry, as a mailing and calling list for salesmen and as a reference book for cost of plant, capacity, load, city lighting contract, kind and price of fuel, population reached, and meters in service.

A special feature of the 1920 edition, now ready for distribution, is an inserted table reprinted from the May 15th issue of the Electrical World. This gives the status of domestic and commercial electric service by states and sections. Men of the West will be especially interested to note that this section of the country ranks highest in the column which gives the percentage of dwellings electrically wired, taking into consideration the total number of dwellings in the territory, and also in the column which shows the proportion of the population living in electrically wired homes.

The electrical industry is changing and growing in leaps and bounds all over the country. New plants are continually being constructed and new inter-connections made. Gas and oil engine development and changes in lighting contracts, fuel prices, personnel and in the population reached by the central station are so numerous that the average man finds great difficulty in keeping abreast with the industry. For this reason the McGraw-Hill Company is rendering a recognized service in bringing every edition of this directory down to the minute.

Determining the Resistance of Metals and Alloys to Wear

The Holz & Company, Inc., Metallurgical Engineers, New York City, are sending upon request their recent book which explains the newly developed methods of determining the resistance of metals and alloys to wear.

The company states that although variations in chemical composition and heat treatment have a decided influence on the wearing properties of metals, it has been definitely established that there is no relation between these properties and the so-called hardness of the metal.

THE COMPASS was invented in 2634 B.C. by Emperor Hon-ang-ti. If you want to get anywhere, start in the right general direction:

THE SEARCHLIGHT SECTION IS AT YOUR SERVICE

NEW ELECTRICAL DEVELOPMENTS

(News on dock and pier construction comes from the Northwest along with reports of plans for improved street lighting systems. The Pacific Central district reports the removal of the ban on the use of electric power for lighting in San Francisco, negotiations between power companies for the purchase of power, and plans for the Hetch Hetchy power plant. Activities of municipal light and power departments are reported from the Southwest and interesting plans for the moving of a city in the construction of a dam are among notes from the Intermountain district.—The Editor.)

THE PACIFIC NORTHWEST

SPOKANE, WASH.—The Washington Water Power Company has announced that steam heating rates in Spokane will be increased from 5 to 15 per cent, due to the increased freight rates on coal.

PORTLAND, ORE.—The Eastern & Western Lumber Company, Portland, have had plans prepared for a power plant to cost $25,000. The structure will be of steel construction with stucco exterior, and will be built by day labor.

STAYTON, ORE.—The Stayton Power Company is increasing the capacity of its plant by the installation of a 210-hp. water wheel. This will give the company additional capacity to take care of growing demands for power.

PORTLAND, ORE.—General Harry Taylor, assistant to chief of the United States Engineers, and six engineers of the war department will visit Portland during October on an inspection tour of the rivers and harbors of the Northwest.

SALEM, ORE.—The Creswill Electric Light & Water Company has filed with the public service commission an application for an increase in rates. It is charged in the company's application that the present revenues of the company are insufficient to pay operating expenses.

BURNS, ORE.—At a meeting of the city council held September 3, estimates for the installation of the proposed municipal light plant, water and sewer system were submitted by I. C. Kelsay, engineer. The estimated cost of the project was given at approximately $300,000.

ST. HELENS, ORE.—Plans for the organization of the Marshland drainage district, comprising some 1000 acres near St. Helens, in Columbia county, have been submitted to the state engineer's office for approval. It is estimated that the development will cost approximately $50,000.

VANCOUVER, B. C.—The Northern Construction Company of Vancouver has been awarded the contract for building the Ballantyne pier and quay. The firm's bid for this work was approximately $4,500,000, and covers the erection of the whole of the big concrete pier and concrete freight sheds and their equipment.

PORTLAND, ORE.—F. H. Barstow, local manager of the Federal Telegraph Company, reports that his company has purchased a large site at Hillsboro, to be used as the location for a wireless station. The plant will consist of a 620-ft. tower to hold two sets of antennae, and other buildings, to cost about $200,000.

CHEHALIS, WASH.—A proposed lighting system is being worked out for the city of Chehalis, the plan being to establish a local improvement district in which the property owners will pay for installing the uniform standard lighting system to take the place of the present inadequate lighting and remove the poles from the main business streets.

PORTLAND, ORE.—The Public Dock Commission has awarded to the Westinghouse Electric & Manufacturing Company the contract for furnishing ten 100-horsepower motors and compensators for the new 15,000-ton drydock to be erected by the Port. The company's bid was $29,040. The only other bid was submitted by Allis-Chalmers Company.

GARIBALDI, ORE.—The installation of the 2000-kw. Curtis turbo-generator at the sawmill of the Whitney Lumber Company at Garibaldi has been completed, and the mill, which is to be electrically driven, will soon be in operation. The generator is being used at present to operate an electrically driven dredge, which is deepening the harbor to accommodate lumber carriers.

ROSEBURG, ORE.—Douglas County Light & Water Company has secured an order suspending the recent rate increase granted by the Public Service Commission, for a period of six months, during which time a new showing will be made in an effort to secure a further advance in lighting and power rates. The company claims it has been operating at a loss due to a large amount of steam operation caused by light rainfall during the last year.

HOQUIAM, WASH.—The only bid submitted to the city council for installing and furnishing electric energy for the boulevard lighting system proposed for the business district was that of the Grays Harbor Railway & Light Company. The bid was much higher than had been estimated by city officials. The company bid $108 per post, whereas the estimate was $85. Energy covering the full night would be charged at the rate of $48 per year for each post, and $35 for a half-night's energy. About 45 posts will be installed.

SALEM, ORE.—Application covering the storage of 1,600,000 acre-feet of water in the upper Klamath lake for the irrigation of lands and development of power in California has been filed with Percy A. Cupper, state engineer, by Roy E. Swigart, president of the Shasta Valley Irrigation Project of Montague, Cal. Some time ago another application was filed by Swigart on behalf of this project, covering the appropriation of 1,500 second-feet of the waters of Klamath river for irrigation and power development. The latest application filed here contemplates the irrigation of approximately 150,000 acres of land.

BELLINGHAM, WASH.—In the condemnation suit of the city of Seattle against the Bingham Investment Company of Sedro Woolley, a jury recently returned a verdict placing the value of the tract of land sought for the Skagit power site at $27,500. The city corporations counsel's office is expected to appeal to the State Supreme Court, objecting to rulings of the judge submitting certain evidence, and also to some of the court's instructions. Charles Bingham, a Sedro Woolley banker, paid $3,000 for the 130 acres of land one year ago. The present value of the land has been placed at all the way from $1,500 to $60,000. Two real estate men valued it at $18,000 to $20,000 for townsite purposes, while engineers said it was worth $60,000 as a site for a hydroelectric plant.

TACOMA, WASH.—The estimated budget for the light and water department for next year, prepared by Commissioner Ira S. Davison, calls for an increase of $10,000 for maintenance and provision for new business, over last year. The department is self-sustaining and the budget is not raised by taxation. Estimated operating revenues for the next year in the light department alone total more than a million dollars. For an increase in operating expenses of the light department of $30,000, the new estimate contains a single item of $25,000 for the purchase of additional power from the Tacoma Railway & Power Company which will be required to run the business. During the next year a large sum will be required for repair and replacing of pipe lines and wooden water mains. Total operating expenses in the light department for the coming year will be $321,600.

THE PACIFIC CENTRAL DISTRICT

OAKLAND, CAL.—Articles of incorporation have been filed by the Berkeley Electrical Company with County Clerk George E. Gross of Oakland. The firm, which will have headquarters in Berkeley, is capitalized at $25,000.

SANTA CRUZ, CAL.—A deed has been filed by which the Mountain Light & Power Company transfers to the Santa Cruz County Utilities, for $550,000, their holdings, the light and power companies of Boulder Creek, Ben Lomond and Brookdale, with their lands, equipment and water rights.

LODI, CAL.—City Engineer C. F. Brazelotti and Street Superintendent Henning have been instructed by the board of trustees to prepare plans and specifications for necessary improvement to streets, sewers, light and water systems as a preliminary to calling a bond election to raise funds. It is thought the amount required will reach $100,000.

EL CENTRO, CAL.—It is announced that the weir installed at Hanlon's Heading cost $30,000 to install, as reported by Supt. Cronholm. He also reports that the peak of water delivery orders has been reduced from 5600 to 5200 ft., which is the supply for the entire valley. There has been no water shortage at any point this summer, nor is any expected.

SAN FRANCISCO, CAL.—Recent heavy rains, bringing up the streams and releasing the power that has formerly been used for irrigation purposes, has caused H. G. Butler, San Francisco power administrator, to lift the ban prohibiting the use of electric power for signs or special display. The new order does not apply to all restrictions on power and certain plants within the city limits are still being restricted.

SAN FRANCISCO, CAL.—The Middle Yuba Hydro-Electric Power Company on Oct. 14 was authorized by the California Railroad Commission to increase its rate for electricity 15 per cent to cover the additional cost of power resulting from a recent increase granted the Pacific Gas & Electric Company which furnishes the Yuba company with electric energy. A public hearing on the company's application for financial relief was held at Grass Valley.

SAN FRANCISCO, CAL.—Gross earnings of the Pacific Gas & Electric Company for the eight months ending August 31 were $2,705,763, according to a report issued by A. F. Hockenbeamer, second vice-president. This is an increase of $5,455,350 in gross over the same period of last year and a gain of $43,745 net income. In the same period there has been an increase of 23,920 consumers which, says the report, is the most satisfactory index of the company's continued and substantial growth, as the earnings for 1920 were influenced to some extent by the new rate schedule.

SAN FRANCISCO, CAL.—Plans for the city's big electric power plant in connection with the Hetch Hetchy project have been started by City Engineer O'Shaughnessy. This is the last large piece of work connected with the mountain division of the city's water project. It is estimated that the plant, with the machinery, will cost about $6,000,000. It is to be built at the foot of what is known as Priest's Hill. The water will have a sheer drop at this point of 1,200 feet, and 400,000,000 gallons a day will pass through the weirs to the turbines.

SAN FRANCISCO, CAL.—An attractive and highly-secured, short-term, tax-exempt investment is offered the public by Freeman, Smith & Camp Company. The issue is $100,000 7 per cent warrants of Sacramento and San Joaquin drainage district. Beginning February 1, 1921, the district will sell bonds after completion of the work to the amount of $5,500,000 to retire those warrants, the total amount of which is $300,000, purchased by a syndicate composed of the state board of control, San Francisco and Chicago banks.

CHICO, CAL.—W. A. Beard of the Sacramento Development Board appeared before the Board of Supervisors here and told of the new plan for building a dam in Iron Canyon, together with a system of irrigation canals, to irrigate land on the east as well as the west side of the Sacramento. A realization of the plan would bring water to the district northwest of Chico, a project which has been under consideration by the Chico Chamber of Commerce for the past six months. The new damsite will be located three miles from the site first proposed, and will store 750,000 acre-feet of water in the cup which is formed by the mountains.

SAN FRANCISCO, CAL.—Completion by the San Joaquin Light & Power Corporation of the Kerckhoff power plant in Fresno county and steam plants at Bakersfield and Midway having made available electrical energy beyond the needs of this company, the Pacific Gas & Electric Company applied to the Railroad Commission to authorize an agreement for the Pacific company to buy the excess energy from the San Joaquin. The Commission was asked to approve a plan by which the Pacific company will advance to the San Joaquin corporation sufficient funds to construct a transmission line from the Kerckhoff plant to the San Joaquin substation at Merced. Delivery to the Pacific company would be made at Newman.

JACKSON, CAL.—The Amador Electric Light and Power Company has been authorized by the Railroad Commission to increase its rates for electric energy. Testimony given at the public hearing of the company's application held at Jackson showed that depression in the mining business has reduced the company's business to such an extent that its revenues are not compensatory. Increased cost of purchased power and materials and labor have also helped to reduce the company's income. No protests against the proposed increase were made at the hearing in Jackson. The Commission's order establishes an entirely new schedule of rates. The increase on the average will amount to about 20 per cent on light and 10 per cent on power.

THE PACIFIC SOUTHWEST

LONG BEACH, CAL.—The Pacific Electric Railway has proposed the construction of an overhead crossing on North Atlantic Avenue.

PASADENA, CAL.—The Pacific Electric Railway will install a double curve at Colorado and Los Robles Ave, the improvement to cost $22,000.

FLAGSTAFF, ARIZ.—The Arizona Lumber & Timber Company will build a dam near its mill, to dam in the waters which in the rainy season flood the city.

POMONA, CAL.—H. E. Boller of Chino has been awarded a contract for a new well in Ganesha Park. It is the intention to put down a well 55 feet below the level of the creek bed.

LOS ANGELES, CAL.—O. A. Smith, general passenger agent of the Pacific Electric, states that the company proposes to proceed with the repairing of the line on Echo Avenue at an early date.

LA VERNE, CAL.—At a mass meeting held in La Verne district, a committee was appointed to wait upon the Los Angeles county supervisors to guarantee the difference between the market and par value of bonds necessary to defray the cost of building Live Oak Dam in the mountains north of La Verne.

RIVERSIDE, CAL.—The directors of the Moreno Mutual Irrigation Company show that the company has acquired 800 acres of water-bearing lands in the San Timeteo canyon. Wells will be sunk on the tract and water carried 12 miles to Moreno Valley. Two thousand acres of dry farming land will thus be irrigated.

LOS ANGELES, CAL.—Chief Engineer Reagan has presented to the Board of Supervisors plans for the purchase of two large control gates to be placed in the tunnel at Devil's Gate Dam near Pasadena. When these gates are placed the dam will be completed. Bids are to be asked for the gates at an estimated cost of $40,000.

LOS ANGELES, CAL.—The Southern California Edison Company has been authorized by the Railroad Commission of California to sell to the Ontario Power Company a 15,000-volt electrical distribution line located on Base Line Road, San Bernardino county, at a price of $12,500. The transfer of the line will make it unnecessary for the Ontario company to build a line of its own.

CASA GRANDE, ARIZ.—Strenuous work is being performed by the Casa Grande Farmers' power committee in their efforts to secure electric power for this valley. They have secured a conditional proposition from the Salt River Valley that they are giving the most favorable attention. Project lines, financing, etc., are being worked out, and the plan of bringing current into this valley, if found practicable, will be given publicity in all its details.

MONROVIA, CAL.—Supervisor Prescott F. Gogswell of Los Angeles states that investigation shows that two or three small reservoirs, which would require the building of comparatively small concrete dams and which would be used for storage purposes, would be much more effective as flood control and conservation measures than check dams. He states that construction of the dams can be commenced as soon as some kind of a road can be built for delivery of materials.

PASADENA, CAL.—The city of Pasadena is investigating the possibility of getting additional current for the municipal light department from hydroelectric development in the San Bernardino mountains . The city commission has authorized an appropriation for expenses to C. W. Koiner, general manager of the municipal light plant, and Chief Engineer Samuel B. Morris of the city water department, for an investigating trip to a hydroelectric plant there. It was stated that the investigation is of power possibilities and not a water supply.

LOS ANGELES, VAL.—In order to meet the growing power needs of the city, Chief Electrical Engineer E. F. Scattergood of the municipal power bureau urged the Public Service Commission to proceed with the construction of the San Fernando and Franklin Canyon municipal power plants. The commission took under advisement the city council's resolution calling upon the commission to go on record to the effect that it will take care of interest and sinking fund charges on all power bond indebtedness out of the department's revenues.

THE INTER-MOUNTAIN DISTRICT

POCATELLO, IDAHO.—The entire city of American Falls, a city of several thousand population, located in southeastern Idaho, is to be moved several miles from its present location, to make room for the construction of a huge irrigation dam on the site of the present town.

ROUNDUP, MONT.—The city council has awarded to the Paulson Construction Company of Butte the contract for furnishing materials and equipping and installing an ornamental street lighting system in special improvement district No. 36. The contract runs about $17,000.

LOGAN, UTAH.—It is reported that the city officials of Logan are considering the matter of calling an election for the voting of several hundred thousand dollars in bonds, the proceeds of which would be used to enlarge the present municipal electric power plant, or possibly to build a new plant.

WOLF POINT, MONT.—A charter has been granted by the state to the Listerud Power Co. of this city with an authorized capitalization of $100,000. The new organization will take over the business and the plant of the Wolf Point Light and Power Company and continue to conduct the business.

NEPHI, UTAH.—The public utilities commission of Utah has made a decision permitting the city of Nephi, which operates a municipal plant, to increase its rates on electric light and power. The lighting rate is increased from 7 cents to 10 cents per kilowatt-hour, with a minimum of $1.00 per month, and the heating and cooking rate from 2 to 3 cents per kilowatt-hour.

MILES CITY, MONT.—The cooperation of the city officials of Miles City, Terry and Glendive will result in the building of a hydroelectric plant at Buffalo rapids capable of generating 15,000 hp., which will eventually be the means of reclaiming 50,000 to 75,000 acres of land in eastern Montana. The project is assured of the necessary capital if the towns to be affected will sign contracts for electric power.

DENVER, COLO.—The Sethman Electric & Manufacturing Company expects to open the first of three buildings of its new plant Jan. 1. One year ago this company was incorporated for $2,000,000, which will later be raised to $10,000,000, according to George H. Sethman, president. The building about completed cost $175,000, with equipment. Following this will be a machine shop covering an entire block.

OGDEN, UTAH.—The contract for the construction of the United States government arsenal building at Sunset, near Ogden, has been awarded. Materials are now being shipped in, and although the work will be rushed, the contract calls for completion of the work June 1, 1921. The plant will consist of about sixty buildings and it is estimated that 1000 horsepower of electrical energy will be required in its operations.

OGDEN, UTAH.—A cooking school, featuring the uses of electricity in the home, was held in Ogden during the week beginning September 27, conducted along similar lines to that held in Salt Lake City during the first part of August. The various merchants and manufacturers of Ogden displayed their products, and a cooking and baking program was carried out, demonstrating the various methods of preparing food products. An expert was on hand to demonstrate the uses of electricity to the housewives.

PROVO, UTAH.—The Utah Power & Light Company has filed an application with the district court of this district for 200 second feet of water, which it claims was filed on but never proved up, in Provo Canyon. The company states that it has spent $2,000,000 in a power plant and flume in the canyon, and that the canal companies will interfere with its use of a total of 400 second-feet of water during the irrigation season, and asks the court to settle this question in the decree.

The true military spirit was displayed by a company of new recruits resting near the bank of a canal. The command of the officer to "Fall in" was followed by a loud splash.

* * *

Salesmanship is applicable to friends and neighbors alike. We didn't invent this story. It's true. A man hurried into Smith's store one morning, and having to wait around for a few moments began to look at an electric sweeper until the proprietor came up to him.

"What are those things worth?" he asked.

"One thousand dollars," replied Smith.

"What?"

"One thousand dollars."

"Sell for one thousand dollars?"

"Oh, heavens, no, you asked me what they were worth. They sell for sixty-five, but I can't sell you that one."

"Why?" challenged the customer.

"Why, because I sold it half an hour ago—but," he whispered, "in my basement, I've—another one."

The man's face registered satisfaction. "I beat rugs all day Saturday. Send it up to my house."

"I'll certainly do that," sang Smith. "If anything goes wrong, let us know, we'll fix it up for you," he continued, taking the money. "I'm glad that you came in to buy a sweeper."

"But I didn't," replied the customer, "I merely dropped in to borrow your wire cutters."

* * *

THINGS THAT NEVER WERE

A woman who could find her car fare within five minutes after boarding a street car.

An edition of the newspaper without a "Great Probe" in it.

A group of passengers who knew exactly where to stand when waiting for a car to stop.

An editorial writer who neither "viewed with alarm" nor "pointed with pride."

A new serial that wasn't the author's "greatest."

A political candidate who didn't carry the washing home for his mother when he was a boy.

An electrical man who never played golf.

A movie comedy in which nobody fell into a rain barrel or a bucket of whitewash.

A plain or unpopular debutante in the society columns of the newspaper.

A newspaper boy with a musical voice and a strict regard for truth.

A car conductor who stopped saying "Step forward, please," when the car was full.

A big rainstorm that wasn't the heaviest the district had known at that season for over thirty years.

* * *

A sign of the times is a notice we saw recently outside a down town hotel:

"Large Dry Basement For Rent."

In 'the-good-old-days' they used to be called cellars.

* * *

PRACTICAL PROBLEMS IN ELECTRICITY

Before the great felicity
Of learning Electricity
Had made of me the whizz I am today,
I used to wonder how, when you
Put on extra lamp or two,
The generator knew it miles away.

And when I heard that if I stood
On insulators, then I could
Quite safely with live wires play around
I wondered how it could be true,
Or how the current ever knew
The other end of me was on the ground.

* * *

A new invention, originating in Holland, is "a telephone small enough for both transmitter and receiver to be carried in the vest pocket."

Very ingenious, but who wants a telephone mixed up with his watch?

* * *

Architecture is very important to the electrical industry, for which reason we quote the following treatise on the subject:

"A great architect is one who has been dead such a long time that he can be copied with impunity.

"A writer must be able to say many offensive things before he can become an authority on architecture.

"A school of architecture is a collection of men with the same unintelligible idea.

"Queen Anne knew nothing at all about the architecture of her period, in which respect she was no worse off than are the people who chatter about it today.

"Success in architecture can be achieved only through the medium of an appropriate vocabulary.

"A flourishing period of architecture in the past was fostered by the church. A flourishing period of architecture nowadays is fostered by the wives of millionaires.

"If bad architecture lasts long enough it becomes good.

"The most devoted lovers of the antique in architecture are the ghosts."

* * *

Only the initiated can understand some advertisements. Among recent items which have mystified us is the following, listed under Fixtures For Sale:

"Two-vault omnibus made in Jamestown."

Now we have seen omnibuses that were fixtures, but we never heard of the owners advertising them. And what is a "two-vault" omnibus, anyway? Does it refer to the method by which passengers board it?

* * *

A report states that "The tin plate market is very quiet." How do they do it?

* * *

Speaking of import duties on luxuries reminds us of Norway's recently published list of import prohibitions. The prohibited luxuries include "carts and carriages for carrying persons whether or not varnished." Which means, we take it, that no amount of "polish" entitles you to a carriage-and-pair. Upholstered furniture is also included as a luxury. Tooth paste, however, is not.